AEROSPACE IN CANADA — OUTLOOK AND STRATEGY

REPORT OF THE ADVISORY COMMITTEE ON AEROSPACE DEVELOPMENT

TO

HON. EDWARD C. LUMLEY, P.C., M.P.
MINISTER OF INDUSTRY,
TRADE AND COMMERCE AND
REGIONAL ECONOMIC EXPANSION

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6 July 1983

The Honourable Edward C. Lumley, P.C. M.P.
Minister of Industry, Trade and Commerce
and Regional Economic Expansion
House of Commons
Ottawa, Ontario

Dear Mr. Lumley:

We, the members of the Advisory Committee on Aerospace Development which you convened on December 20, 1982, to provide advice on the future of the Canadian aerospace industry in Canada, have the honour to submit the following report:

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President
Aerospace Industries Association
of Canada

Mr. Mike Rygus
General Vice President
International Association of
Machinists and Aerospace Workers

Members

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Fleet Industries
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MacDonald Dettwiler & Associates

Mr. John W. Sandford
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The de Havilland Aircraft of
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Mr. Elvie Smith
President
Pratt & Whitney Canada Inc.

Mr. Robert Nickerson
Administrative Assistant
United Automobile Aerospace &
Agricultural Implement Workers
of America

Mr. William C. Tate
Vice President & General Manager
Garrett Manufacturing Limited

TABLE OF CONTENTS

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
	ACKNOWLEDGEMENTS	i
1.	EXECUTIVE SUMMARY	1-1
2.	INTRODUCTION	2-1
3.	OVERVIEW OF INDUSTRY 1982 AND FORECAST ITC DATA ANALYSIS	3-1
	3.1 Gross Sales	3-1
	3.2 Foreign Trade	3-2
	3.3 Value Added	3-9
	3.4 Annual Investment	3-9
	3.5 Employment & Wages	3-9
4.	DEVELOPMENTS WITH SIGNIFICANT IMPLICATIONS FOR CANADIAN AEROSPACE INDUSTRY	4-1
	4.1 Industry	4-2
	4.1.1 Commercial Aircraft	4-3
	4.1.2 General Aviation and Utility Aircraft	4-7
	4.1.3 Commercial and Military Aircraft Subcontracts	4-9
	4.1.4 Military Aircraft	4-12
	4.1.5 Aircraft Repair and Overhaul	4-13
	4.1.6 Surveillance Systems	4-13
	4.1.7 Engines	4-15
	4.1.8 Aircraft Engines Repair and Overhaul	4-17
	4.1.9 Avionics and Electronics	4-18
	4.1.10 Satellites and Ground Stations	4-21
	4.1.11 Simulators	4-22
	4.1.12 Powered-Lift Technology	4-24
	4.2 Aerospace Skilled Human Resources	4-25
	4.3 User/Services	4-27
	4.3.1 Department of National Defence	4-27
	4.3.2 Department of Supply and Services (DSS)	4-29
	4.3.3 Defence Programs Branch	4-31

TABLE OF CONTENTS

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
	4.4 Institutional Observations	4-34
	4.4.1 World Product Mandate	4-34
	4.4.2 Defence Industry Productivity Program (DIPP)	4-35
	4.4.3 Research and Development	4-37
	4.4.4 Export Sales Financing	4-38
	4.4.5 Domestic Sales Financing	4-40
5.	STRATEGIC IMPLICATIONS	5-1
	5.1 General Industry Structure	5-1
	5.1.1 Traditional Areas of Expertise	5-1
	5.1.2 Market Niches/Windows	5-1
	5.1.3 Vertical Integration	5-1
	5.1.4 Joint Ventures	5-2
	5.1.5 Subcontracting Roles	5-2
	5.1.6 Changing World Environment	5-4
	5.1.7 Industry Modernization	5-4
	5.1.8 Productivity Improvements	5-4
	5.1.9 DND/DOT Procurement Policies	5-5
	5.1.10 Industrial Benefits Programs	5-5
	5.1.11 Skill Up-grade Programs	5-7
	5.1.12 Systems Integration	5-7
	5.1.13 World Product Mandate (WPM)	5-7
	5.2 Major Programs	5-8
6.	PRIORITIES FOR DEVELOPMENT ASSISTANCE	6-1
7.	RECOMMENDATIONS	7-1
	7.1 Productivty Improvement	7-1
	7.2 Research and Development	7-2
	7.3 Human Resources	7-3

TABLE OF CONTENTS

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
7.4	Technology Transfer	7-4
7.5	Trade Finance	7-4
7.6	Government Procurement	7-5
7.7	Systems Integration	7-6
7.8	Space	7-6
7.9	Major Projects	7-6
7.10	World Product Mandate	7-7
7.11	Statistical Base	7-7

APPENDIX A - AVIONICS & ELECTRONICS PRODUCT LISTING

APPENDIX B - CRITERIA EVALUATION PROCEDURE

APPENDIX C - GLOSSARY OF TERMS

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LIST OF TABLES

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
2.1	MINISTER'S ADVISORY COMMITTEE ON AEROSPACE DEVELOPMENT TERMS OF REFERENCE	2-2
3.1	SALES BREAKDOWN BY SECTOR BY PRODUCT LINE	3-7
6.1	PROJECT EVALUATION CRITERIA	6-2

LIST OF FIGURES

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
3.1	GROSS INDUSTRY SALES ($)	3-3
3.2	GROSS INDUSTRY SALES (%)	3-4
3.3	INDUSTRY SALES	3-5
3.4	INDUSTRY SALES	3-6
3.5	INDUSTRY FOREIGN TRADE	3-8
3.6	INDUSTRY VALUE ADDED	3-10
3.7	ANNUAL INVESTMENT	3-11
3.8	TOTAL AEROSPACE INDUSTRY	3-12
3.9	GROSS INDUSTRY SALES RATIOS	3-14
6.1	CRITERIA RANKING	6-3

ACKNOWLEDGEMENTS

The Advisory Committee wishes to acknowledge the contribution of several key persons and organizations who have made major contribution to the Canadian Aerospace Development strategy outlined in this report.

The task could never have been undertaken without the mandate from the Minister of Industry, Trade and Commerce and Regional Economic Expansion, the Hon. Edward C. Lumley, who initiated the process and provided the necessary assistance and advice to enable the report to be completed within a short period of time and at a reasonable cost to the taxpayers of Canada.

The importance of the Federal Government's role in the study was significantly enhanced by the participation, as an ex-officio member of the Advisory Committee, of Mr. Tim Garrard, Director, Development Projects, and his colleague John Barker, Aerospace Sector Analysis, who provided sound advice and made important contributions to the statistical data contained in the report.

The Committee is also indebted to Aviation Planning Services Ltd., whose staff, headed by Mr. Eric McConachie, President and Mr. Richard S. Fisher, Vice President, undertook the onerous responsibility of overseeing the co-ordination, drafting and production of this report in a limited period of time. They are to be commended for the professional manner in which they carried out the assignment.

Appreciation must also be extended to the individual members of both industry and organized labour, who gave freely of their time over a lengthy period, and whose contributions cannot be overlooked.

Finally, although the Committee is grateful for all the assistance received, it necessarily bears full responsibility for the contents and recommendations contained in this report.

1. EXECUTIVE SUMMARY

The following summary provides an overview of the major findings, conclusions and recommendations of the report. It has been organized in the same order as the overall study. However, the Committee cautions that it provides only the highlights of the complete volume, and the reader is referred to Sections 3 through 7 for more detailed information and analysis.(1)

1.1 Overview of Industry and Forecast

The following historical information was obtained from an AIAC/DRIE questionnaire covering the year 1982, which was returned by 55 companies, representing an estimated 90 per cent of industry gross sales.

For 1982, industry sales totalled $2.8 billion, and are expected to rise to $6.0 billion in 1987. In 1982, 77 per cent of total sales were in the export market, a figure which would be even higher if P&WC engine deliveries to DHC for exported airframes were themselves considered as exports. Of total sales 42 per cent were in the airframe sector, 28 per cent in the engine sector, with the remainder subdivided between avionics/electronics, space, and miscellaneous categories.

Annual investment in new plant construction, machinery, equipment, and research and development totalled $425 million in 1982, or about 15 per cent of sales. This is expected to increase to an annual level of $500 million over the next few years.

Industry employment totalled 36,320 workers in 1982. Although this figure has dropped somewhat in 1983, it is expected to increase to the 44,000 level by 1987. The average wage for 1982 was $23,000, and the value of additional fringe benefits added another $5,000. The value of sales per employee in 1982 was in excess of $75,000.

The aerospace industry is a dynamic and technologically advanced element of the Canadian industrial base, as will be shown in subsequent sections of the report. Being at the forefront of technology in a number of areas can be financially risky, however the benefits to the country of such an industry more than overcome

(1) See Appendix C for a glossary of acronyms used in this report.

such risks. The advent of the newly industrialized countries into the world aerospace industry supports this thesis and, for Canada to remain competitive, the industry must grow and develop along the lines recommended in this report.

1.2 Developments with Significant Implications for Canadian Aerospace Industry

In addition to statistical analyses, the Committee received over forty individual briefings from representatives of industry, labour and user/services groups, in order to obtain a better understanding of how the various subsectors viewed their prospects and potential problems. As the great variety of presentations makes them difficult to summarize, the reader is referred to Section 4 of this report for more detailed information. The briefings included submissions in the following areas:

- Programs
  - Commercial Aircraft
  - General Aviation and Utility Aircraft
  - Commercial & Military Aircraft Subcontracts
  - Military Aircraft
  - Aircraft Repair and Overhaul
  - Surveillance Systems and Missiles
  - Engines
  - Engine Repair and Overhaul
  - Avionics and Electronics
  - Satellites and Ground Stations
  - Simulators
- Human Resources
  - International Association of Machinists and Aerospace Workers
  - Department of Employment and Immigration
  - AIAC Human Resources Committee
- User/Services
  - Department of National Defense
  - Department of Supply and Services
  - Defence Programs Branch
- Institutional Considerations
  - World Product Mandate
  - Defense Industry Productivity Program
  - Research and Development
  - Export Sales Financing
  - Domestic Sales Financing
  - Powered Lift Technology

1.3 Strategic Implications

As a result of the industry/labour briefings and further discussions with knowledgeable persons in both areas, a number of key factors or strategic elements affecting the aerospace industry have emerged. These have been summarized as follows:

1.3.1 Traditional Areas of Expertise

Since World War II, the Canadian aerospace industry has developed expertise in, and has successfully marketed, equipment and systems in several broad categories such as STOL transports, simulators, small gas turbines, surveillance drones etc. A vast body of knowledge has been built up in these areas, leading to a natural competitive advantage in terms of follow-on systems. It is incumbent upon industry to make maximum use of its existing strengths, by continuing to develop improved products in those areas where Canada is strongest.

1.3.2 Market Niches/Windows

With a relatively small domestic market and limited industrial capacity Canada cannot hope to successfully compete on an across-the-board basis with industrial giants such as the U.S. Canada can, however, by judicious selection of market niches or windows, provide a concentrated effort in specific areas which can be highly profitable. For this strategy to be successful, it is necessary to identify the technical opportunities at an early stage, and provide adequate R&D funding in order to develop a strong competitive position at the earliest possible date.

1.3.3 Vertical Integration

Canada is a world-leader in certain selected primary products and systems. Both the Government and industry, through their control of these products, have an obligation to maximize the use made of Canadian procured subsystems and parts, insofar as possible. In some cases, it may be possible for a prime contractor to actually assist in developing Canadian companies with new (to Canada) technologies,

through early identification of requirements and judicious application of subcontracting procedures. The probability of success will be enhanced if the major system is indigenous to Canada.

1.3.4 Joint Ventures

The development of more joint ventures in aerospace is an area which needs further exploration. This applies particularly to the field of systems integration, where, individually, a firm would not qualify but, in conjunction with other firms with complementary abilities, could obtain the business.

1.3.5 Subcontracting Roles

At present, the large part of the industry subcontract work is tendered, on a competitive basis, to a major (usually U.S.) original equipment manufacturer. This system, while effective in the past, is open to much more competition and our continued participation may be jeopardized unless a modified approach is adopted.

1.3.6 Changing World Environment

Prior to World War II, only half a dozen countries in North America and Western Europe had been able to establish a comprehensive aerospace capability. Since that time, sophisticated manufacturing and assembly equipment has been installed in such diverse, less-developed countries as Indonesia, India and Romania. These states have determined that a viable aerospace industry is an important national goal, and have developed industrial strategies to implement that goal. Canada must rapidly increase its technological level, if it is not to be squeezed out of the market by the rapidly industrializing Third World.

1.3.7 Industry Modernization

It is becoming more evident all the time that for the subcontract sector of the industry to survive it is essential that the basic plant and equipment be modernized. As a result of the rapid development in computer aided manufacturing, even the smallest shops will have to be capable of accepting electronic instructions, as against line drawings, if they are to remain competitive.

1.3.8 Productivity Improvements

The aerospace industry is world-wide in scope, and almost all products face multinational competition. As Canada is a net exporter of aerospace products, it cannot a.ford to protect its own industry through tariff barriers, and must therefore remain competitive on a world-wide basis. Thus, productivity must continue to improve if competitive pricing is to be maintained.

1.3.9 DND/DOT Procurement Policies

The Canadian Aerospace industry is not benefitting to the extent possible, from the very large DND and, to a lesser extent DOT, expenditures in new programs. Their policy of off-the-shelf procurement produces little net gain in enhanced industrial capability, and the resultant balance of trade improvements which would be expected. It is incumbent upon the government, if this high technology sector is to continue to provide the high ratio of exports to sales now experienced, to examine this situation with respect to both military R&D and the concomitant production. Continuation of the present situation will further reduce the industry competitiveness in the world market, and eventually lead to its demise.

1.3.10 Industrial Benefits Programs

Since DND procurement of Canadian designed equipment has been of minor impact, the only fall out from the present procurement policies is essentially a "build-to-print" capability developed through the industrial benefits programs, without any real state-of-the-art improvement in engineering or design. Such programs do provide short term employment, but rarely develop into long term programs because the underlying technology, which is continually evolving, belongs to the original manufacturer and is seldom transferred. The implications of continuing to stress for industrial benefits as against more direct involvement in the R&D, design and production of specific products or subcomponents must be assessed.

1.3.11 Skill Up-grade Programs

In view of the extensive restructuring of the industry brought about by the increased use of CAE, CAD/CAM, robotics and other productivity improvement technology and machinery necessary for industrial survival in the coming decade, it is essential that the aerospace labour force be trained and also retrained, as required, to enable the industry to take full advantage of the new technologies.

1.3.12 Systems Integration

The requirement for more closely integrated operational systems, particularly in the military avionics area, is becoming increasingly evident and, in order to enable the industry to respond to these requirements, a stronger approach must be made in conjunction with the Government to expand the capabilities in this area.

1.3.13 World Product Mandate (WPM)

It was noted that the WPM was a successful route taken by a number of companies who are subsidiaries of foreign firms. The development of effectively indigenous products by these firms, supported by the technology and marketing of the parent firm, has proven to be of direct benefit to Canada.

1.3.14 Major Programs

In view of the lack of definition received to date on any major program, regarding the Canadian work package, investment requirements, timing and other basic factors, it was the view of the Committee that it should simply suggest the basic strategy guidelines which might influence the Canadian position. It was agreed that the following points be taken into consideration in evaluating these programs:

- A minimum risk approach should be adopted. This could mean a pre-selected subcontractor role, if at all possible.

- A lead company approach should be utilized in which a major Canadian firm acted on behalf of all other subcontractors.

- The options should be kept open as long as possible with the OEM's in order to obtain the most suitable arrangement.

- No program should be entered into unless it meets the test of economic viability.

1.4 Priorities for Development Assistance

Although it was originally anticipated that this report would provide a ranking of importance of various aerospace projects relative to the availability of developmental funding or other assistance, the Committee has determined that it would not be feasible to attempt to evaluate the projects in view of the conflicting views of its constituent members. Therefore, the Committee decided to limit its actions in this area to the development of a series of criteria and their relative weights, by which these projects can then be evaluated in the proper context.

The Committee selected nine key criteria for the analysis. Based on a 50:50 weighting of the average industry and labour scores, the results were:

Criteria	Weighted Average Score
Overall Sales	17.2
Jobs Created	14.8
Return on Investment	14.8
Manpower Availability	10.6
Minimization of Financial Exposure	10.6
Facilities Availability	8.8
Technological Advancement	8.8
Use of Indigenous Products	8.1
Regional Diversification	6.3
	100.0

The Committee has agreed to recommend the use of the average scores, as shown above. A more detailed explanation of the evaluation system is discussed in Section 6 and Appendix B.

1.5 Recommendations

The Advisory Committee on Aerospace, after extensive briefings and discussions with representatives of many sectors of the industry, as well as governmemt, has agreed that there are a number of factors under the control, either wholly or in part, of the government which should be addressed by the Minister or his Cabinet colleagues. The following recommendations for action on the part of government by no means precludes, or limits, the quite often corresponding action required by

industry or labour; it is intended to focus the government attention to those elements which are deemed to be of direct significance to the ongoing development and growth of the Canadian aerospace industry. The specific recommendations are summarized below:

1.5.1 Productivity Improvement

- Industry is committed to a full program of productivity improvement with targets of 5 per cent gain in 1984 and 6 per cent gain in 1985.

- The Industry supports the creation of a National Productivity Centre. The CLC will consider the merits of participating in this Centre when full information about its operations is received from the government.

- The Capital element of DIPP should be available to encourage all firms to increase productivity.

1.5.2 Research and Development

- Industry commits to an R&D budget of 10 per cent of sales per year.

- Government should plan to support industry on the basis of longer term sector plans.

- Government grants should be subject to performance conditions and be repayable.

1.5.3 Human Resources

- Broader based training should be undertaken by industry and the educational systems.

- The grant/levy system of funding should be examined and developed by a joint labour/industry Committee at the national level.

- Industry should provide the Unions and employees sufficient advance notice of their investment plans and the introduction of new technologies, so that the parties can negotiate the impact on the workers and the jobs before such changes are introduced.

- Retraining of displaced workers should be accelerated.

1.5.4 Technology Transfer

- Canada should ensure that one of the key elements of DPSA, which is to transfer new technology, should be fully operative and not be countered by protectionist measures.

1.5.5 Trade Finance

- Canada should support the GATT aircraft agreement.
- EDC should have access to funds to be utilized in any action against violators.
- EDC should commit support, on a "subject to" basis, at a much earlier stage.
- A responsive policy to increasing use of barter and counter-trade should be developed.
- The feasibility of aligning Canadian lease tax benefits with those available in the U.S., should be examined for use as a sales promotion tool.

1.5.6 Government Procurement

- The DND policy of off-the-shelf procurement should be reviewed.
- The Defence Development Sharing Program should be revitalized in preference to the current practice of trading in offsets.
- DND should commit to more capital purchases in Canada.
- DND capital budget should be increased, as required, to cover the above.

1.5.7 Systems Integration

- Industry and Government should work closely together to expand our indigenous systems integration capability.

1.5.8 Space

- At least one major space program should be in the build phase at any one time.

1.5.9 Major Projects

- A lead company approach be adopted in which a major firm acts as prime and brings maximum design and manufacturing benefit to Canadian industry.

- A minimum risk role be assumed which could mean that of a preselected subcontractor.

- Possible options within each major program such as helicopters and transport aircraft should be kept open as long as necessary to compare and evaluate all options.

- Any program entered into must meet the test of economic viability.

1.5.10 World Product Mandate

- Firms pursuing business under a WPM should have priority for government support.

- Products obtained under industrial benefits programs should be subject to a WPM.

1.5.11 Statistical Base

- Industry and Government must work jointly to improve the collection and analysis of aerospace data, which is currently deficient in a number of areas.

2. INTRODUCTION

The following report has been prepared at the request of the Minister of Regional Industrial Expansion, as a result of Terms of Reference (shown in Table 2.1) as approved at a meeting of the Minister's Advisory Committee on Aerospace Development, held in December, 1982.

The Advisory Committee is one of a number established by the Minister to provide him with the collective views of Industry and Labour as to direction a specific industrial sector is expected to take and advise on the problems which may be encountered, as well as possible solutions.

Specifically, the objective of the aerospace industry review is not only to delineate those areas where government assistance can produce or foster the future growth of the industry, but also to assist, where possible, in the decision as to Canada's participation in some major aerospace projects.

Because of the widely varied characteristics of the aerospace industry, which consists of the manufacture and support of airframes, as well as engines, avionics, and space products, it is a very complex industry to analyze and assess in the manner desired by the Minister. Also, due to the mix of civil and military products, each with its own criteria for market acceptability, it has been necessary to develop the view of Committee in terms of these differing requirements within the aerospace sector.

In the course of this review, the Committee has attempted to respond to the points raised in the Terms of Reference as closely as possible. Where this was not feasible due to unavailability of program data or for proprietary reasons, it has been so stated. It should be noted that, in the report, a number of the items listed separately in the Terms of Reference have been covered within broader sub-sections, so do not appear in the index, for example.

The final recommendations are believed by the Committee to encompass the major points of concern to the industry and, hopefully, will provide the basis for an on-going dialogue with the Government with respect to the future of this high-technology sector of Canadian Industry.

TABLE 2.1

MINISTER'S ADVISORY COMMITTEE ON AEROSPACE DEVELOPMENT

TERMS OF REFERENCE

The Committee shall provide advice to the Minister of Regional **Industrial** Expansion:

i) on commercial and technological developments in international and Canadian markets that have significant implications for Canadian aerospace, space and avionics;

ii) on the strategy, the organization and the means for the development of the sector in a commercially-sound manner;

iii) strategic implications and commercial aspects of specific major aerospace projects;

iv) on priorities for investment of developmental assistance by the government;

v) on the impact of government procurement in Canada, the United States and NATO;

vi) on the domestically trained manpower needs;

vii) on the sourcing strategies that will achieve maximum industrial benefits related to international, national or company procurement;

viii) on trade financing and counter-trade practices.

14 January 1983

3. OVERVIEW OF INDUSTRY 1982 AND FORECAST ITC DATA ANALYSIS

The statistical overview and analysis of the aerospace industry contained in this section has been assembled from data provided by the industry on an annual questionnaire, and submitted each spring. All analyses developed here are based on the results of the 1983 responses. It should be noted that, while the request for data is sent out by AIAC, all processing is handled by DRIE, and confidentiality is preserved. 1979-1982 information is considered as actual, while 1983-1987 are projections.

In 1982, 55 companies responded to the questionnaire which, DRIE estimated, totals to approximately 90 per cent of industry gross sales. However, certain key companies (notably CAE and Dowty) are included with the non-respondents, which may bias certain subsector (e.g. simulators) analysis. Although it is possible to adjust the data to account for the missing information,[1] it was believed that, for the purposes of the exercise, it made more sense to work with actual responses only, as the probability of error increases as the data is sliced into finer and finer components.

The questionnaire format divides the industry into five sectors, as follows:

- airframe
- engines
- avionics/electronics
- space
- other

Although a finer breakdown would be desirable, these divisions have been maintained for the sake of consistency.

3.1 Gross Sales

For 1982, gross total industry sales by reporting companies totalled $2.76 billion, a figure which is

[1] AIAC, in fact, provides its annual forecasts on such an adjusted basis.

expected to rise to over $5.96 billion in 1987 (current dollars). These totals are plotted in Figure 3.1. The average annual rate of increase (1982-1987), as projected for the major components, are as follows:

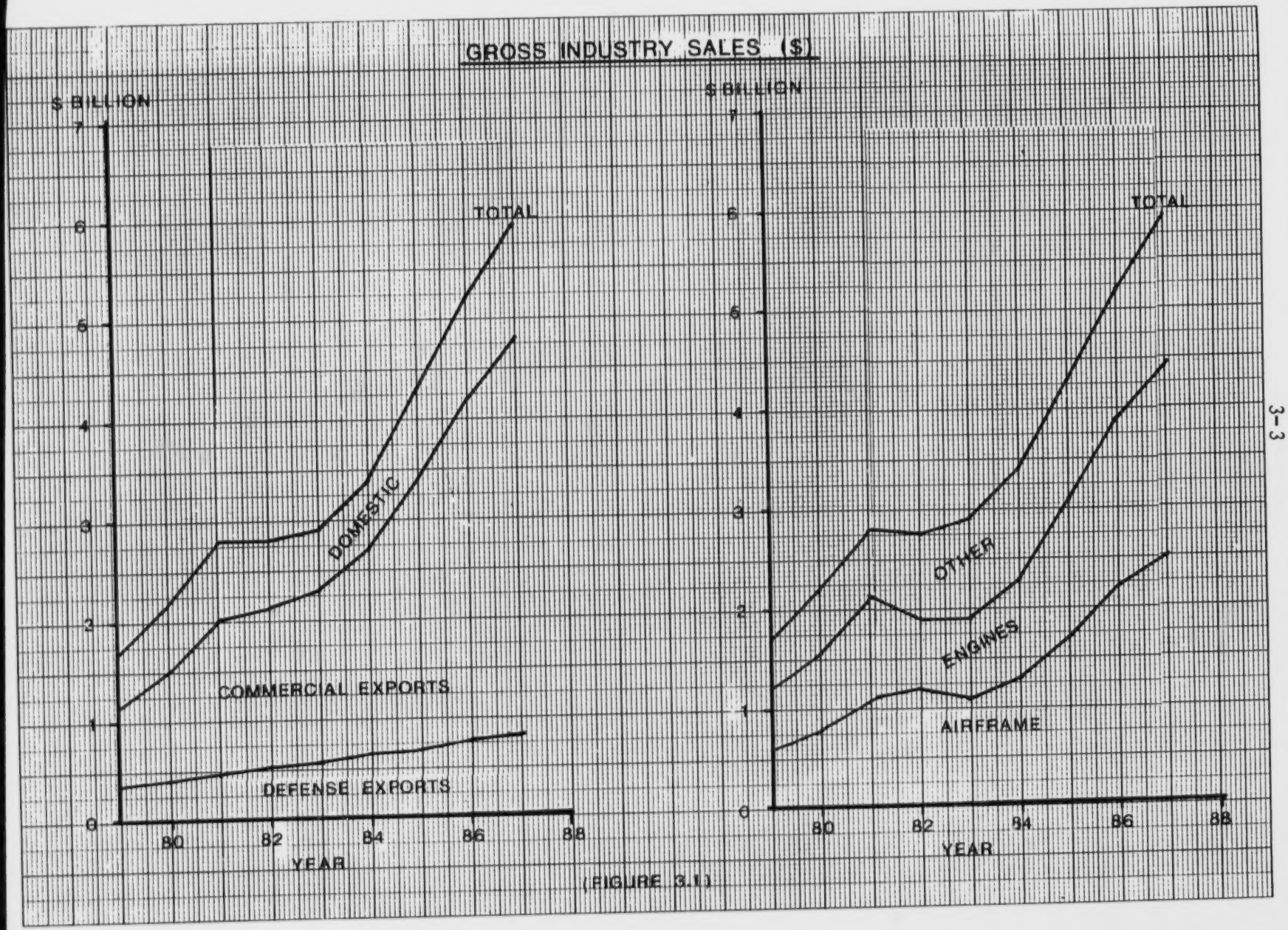
	Per Cent
Industry Sales	16.6
Domestic Sales	12.9
Export Sales	17.6
Airframe Sales	16.5
Engine Sales	20.2
Avionics/Electronics	10.6
Space Sales	16.8
Other Sales	13.6

Figure 3.2 plots the above data as a percentage of total sales. It shows a forecast of export sales rising from 77 per cent to 80.5 per cent of the total, while commercial sales increase from 58 per cent to 66 per cent. When subdivided by sector, airframe sales are expected to remain at 42 per cent of the overall total, while engine sales increase from 28 per cent to 33 per cent.

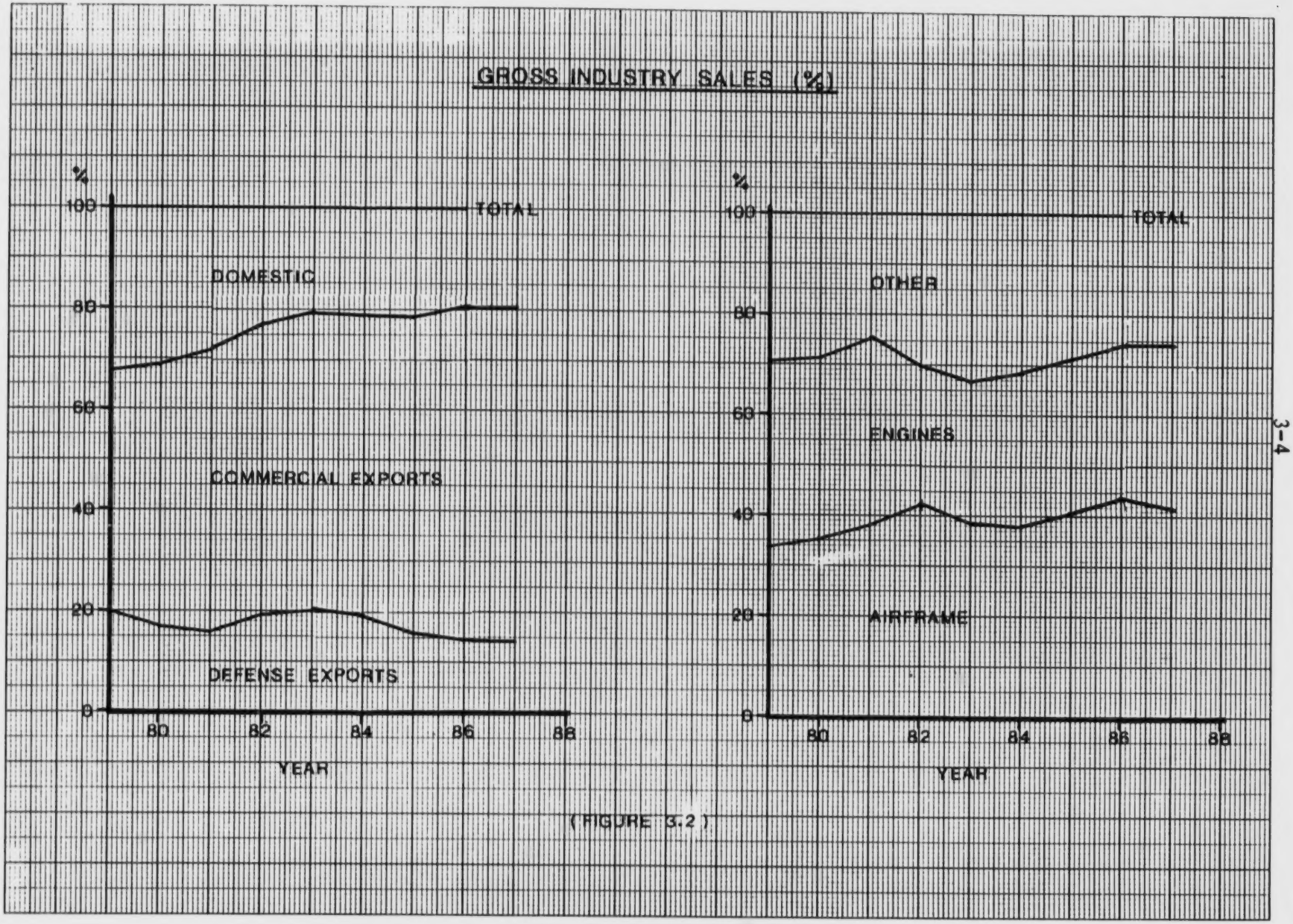
A more detailed breakdown by sector is shown in Figures 3.3 and 3.4, and arranged tabularly in Table 3.1, for current levels (1982). These figures more clearly show the differences in customer categories among the various subsectors. While airframe and engines sales are predominately to foreign commercial customers, the avionics/electronics group sells more heavily to the federal government and domestic defence contractors. The space subsector sells predominately to the Canadian and U.S. Governments and to foreign commercial firms.

3.2 Foreign Trade

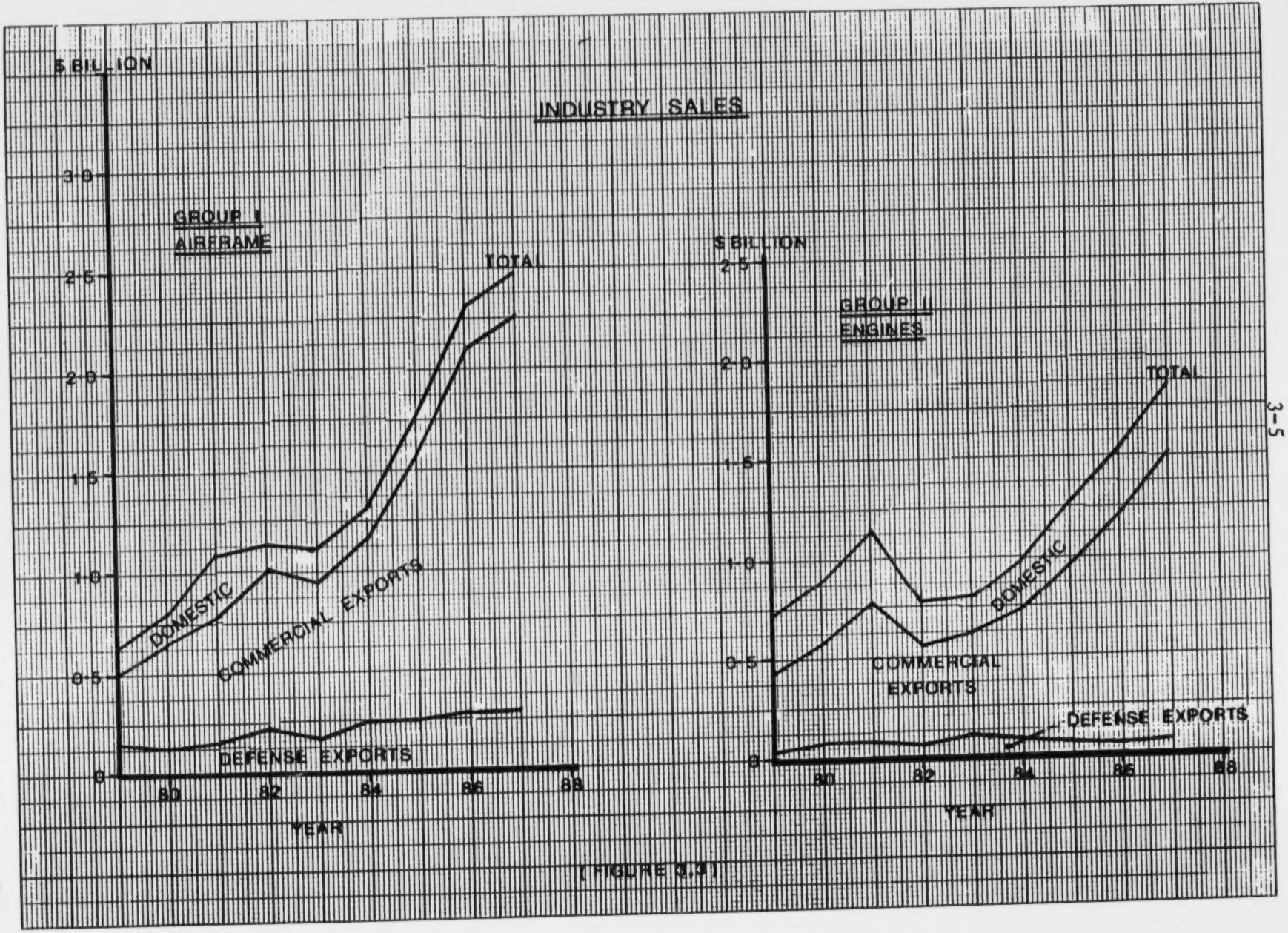
The aerospace industry is predominately export-oriented. To support this level of exports, however, a substantial amount of materials and supplies must be imported. The relationship between these two factors is shown in Figure 3.5. The ratio of industry exports to imports was 3.11 in 1982, and is expected to rise to 3.45 by 1987.


GROSS INDUSTRY SALES ($)
$ BILLION
7
6
5
4
3
2
1
0
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR
$ BILLION
7
6
5
4
3
2
1
0
TOTAL
OTHER
ENGINES
AIRFRAME
80
82
84
86
88
YEAR

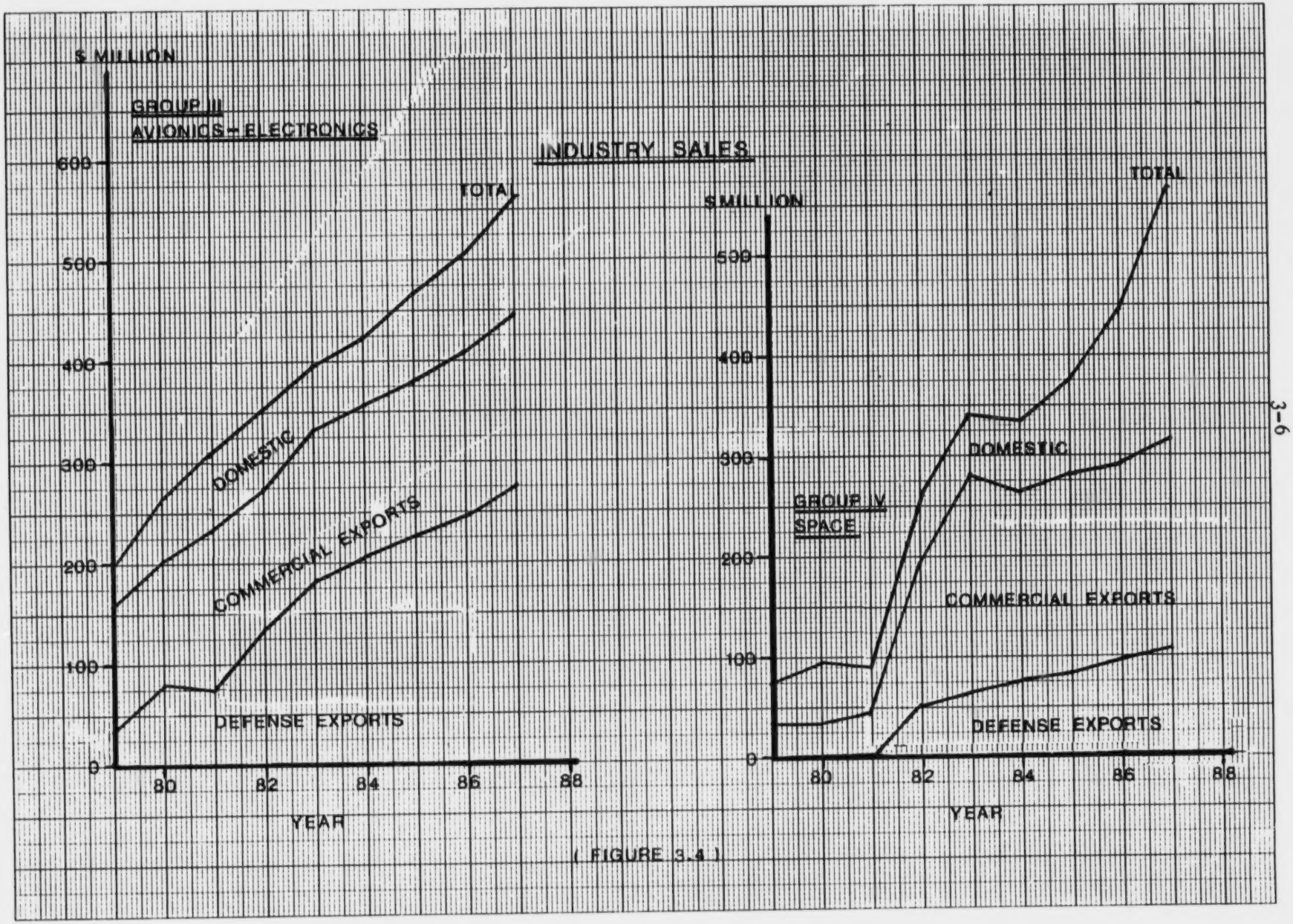
(FIGURE 3.1)


GROSS INDUSTRY SALES (%)
%
100
80
60
40
20
0
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR
%
100
80
60
40
20
0
TOTAL
OTHER
ENGINES
AIRFRAME
80
82
84
86
88
YEAR

(FIGURE 3.2)


INDUSTRY SALES
$ BILLION
3·0
2·5
2·0
1·5
1·0
0·5
0
GROUP I
AIRFRAME
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR
$ BILLION
2·5
2·0
1·5
1·0
0·5
0
GROUP II
ENGINES
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR

[FIGURE 3.3]


INDUSTRY SALES
$ MILLION
GROUP III
AVIONICS - ELECTRONICS
600
500
400
300
200
100
0
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR
$ MILLION
500
400
300
200
100
0
GROUP V
SPACE
TOTAL
DOMESTIC
COMMERCIAL EXPORTS
DEFENSE EXPORTS
80
82
84
86
88
YEAR

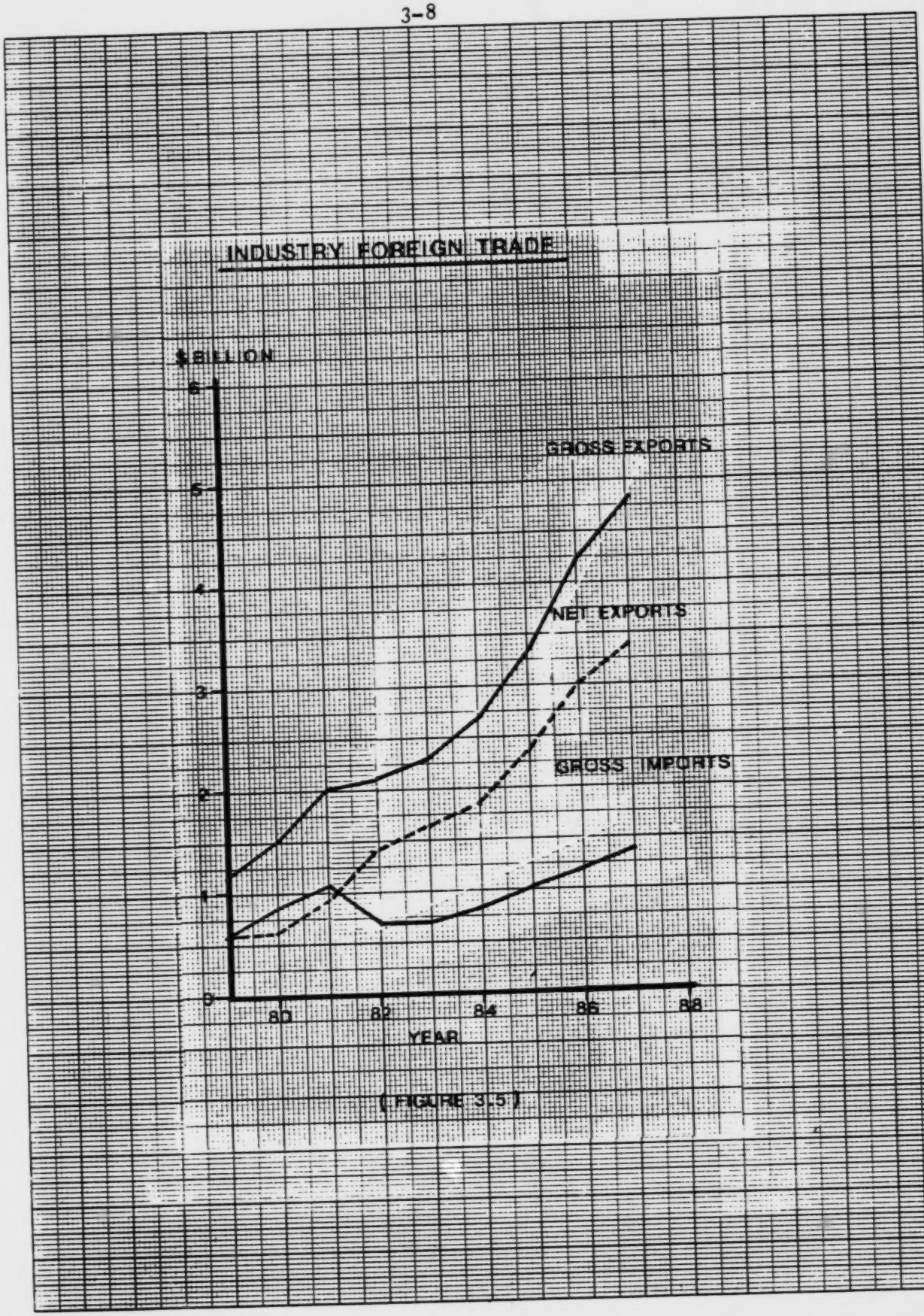
(FIGURE 3.4)

TABLE 3.1

SALES BREAKDOWN BY SECTOR BY PRODUCT LINE

	PER CENT OF TOTAL SALES, 1982					
	AIRFRAME	ENGINES	AVIONICS ELECTRONICS	SPACE	OTHER	TOTAL
Domestic:						
- to Government	6	10	17	20	18	11
- to Aerospace Industry	4	5	3	4	7	4
- other	2	14	4	7	15	7
Sub-Total	12	29	24	31	40	22
Export to U.S.:						
- to U.S. Government	2	4	12	26	16	5
- to U.S. Defence Industry	6	3	29	11	16	10
- to U.S. Commercial Customers	48	39	24	8	18	37
Sub-Total	56	46	65	45	50	52
Other Exports:						
- to other Governments	4	4	5	7	3	10
- to other Defence Customers	13	1	4	3	4	2
- to other Commercial Customers	15	18	2	14	3	13
Sub-Total	32	23	11	24	10	25
Total Exports	88	69	76	69	60	77
TOTAL	100	100	100	100	100	100

SOURCE: DRIE, AIAC, APS Analysis


INDUSTRY FOREIGN TRADE
$ BILLION
6
5
4
3
2
1
0
GROSS EXPORTS
NET EXPORTS
GROSS IMPORTS
80
82
84
86
88
YEAR

[FIGURE 3.5]

3.3 Value Added

A measurement of value added can be generated by comparing the statistics by company sales with materials and supplies purchased, as shown in Figure 3.6. According to the forecasts, value added will increase substantially.

3.4 Annual Investment

The term "investment", as used in this section, refers to the annual investment in new plant construction, machinery, equipment and research and development, and does not refer to the more commonly used overall book value.

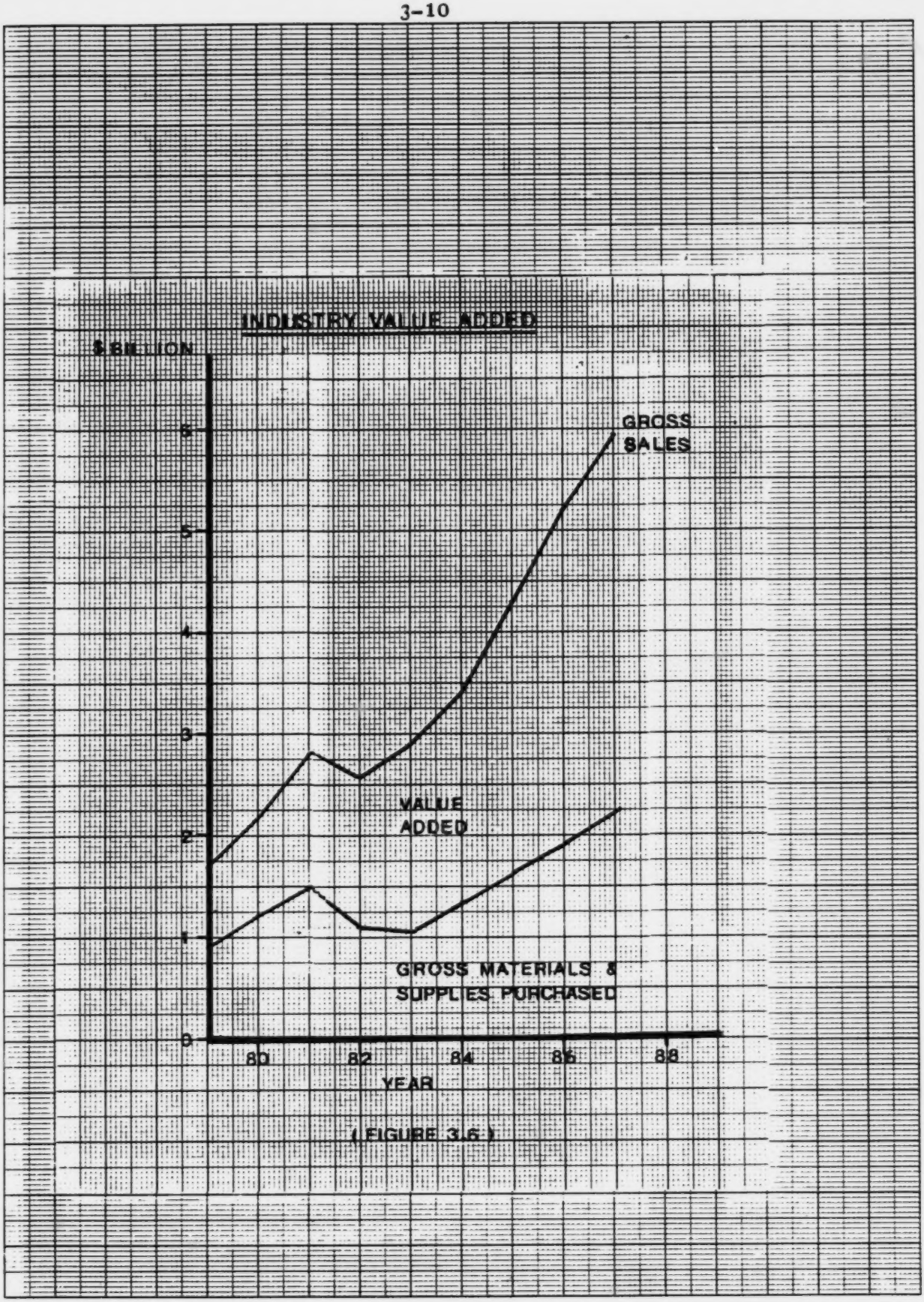
Figure 3.7 shows these values for the industry as a whole. For the post 1983 period, the annual level is estimated to remain constant at the $500 million level.

3.5 Employment & Wages

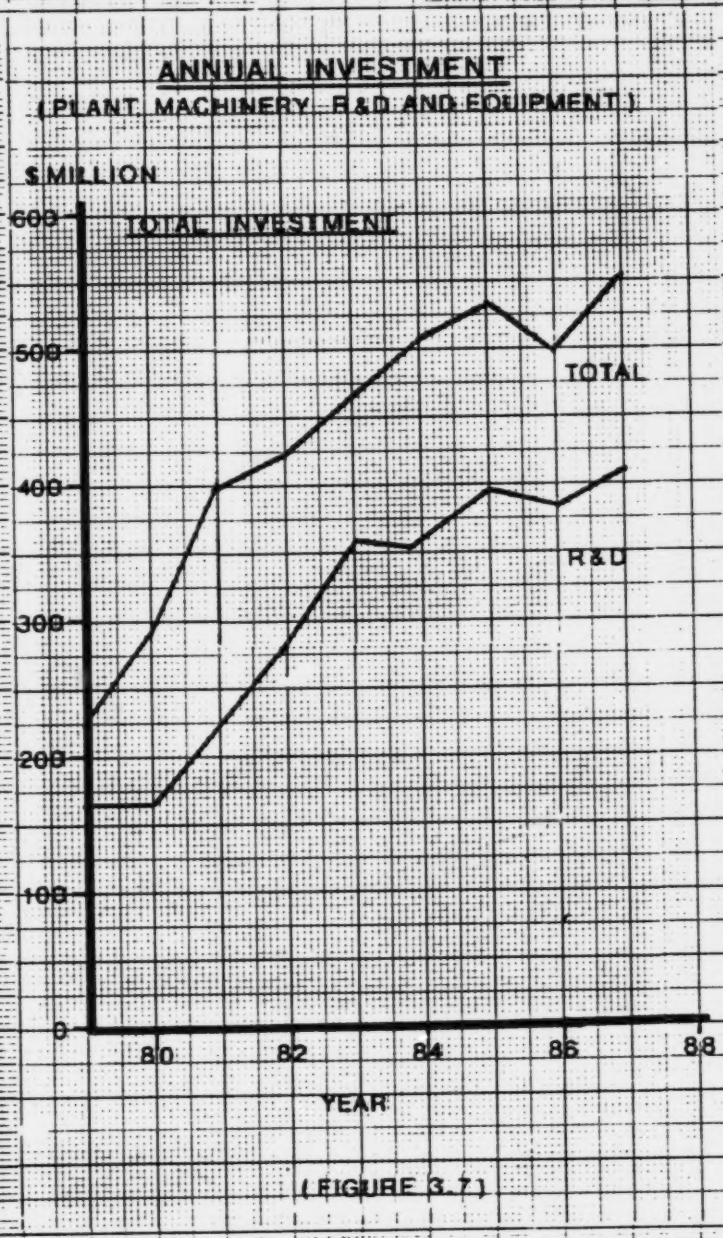
Figure 3.8 plots industry wide employment levels and average industry wages, and average employment cost (including fringe benefits). Fringes are expected to increase from 19 per cent of wages in 1982, to about 25 per cent in 1987. The average annual growth rate for the five year period average 7 per cent for employment cost per employee, and 5 per cent for unit wages and salaries alone. Overall employment is expected to grow from a low of 36,000 in 1982, to reach 44,000 by 1987.

It should also be noted that the fringe benefit level varies substantially among sectors. Actual 1982 data for fringe benefits as a per cent of wages was as follows:

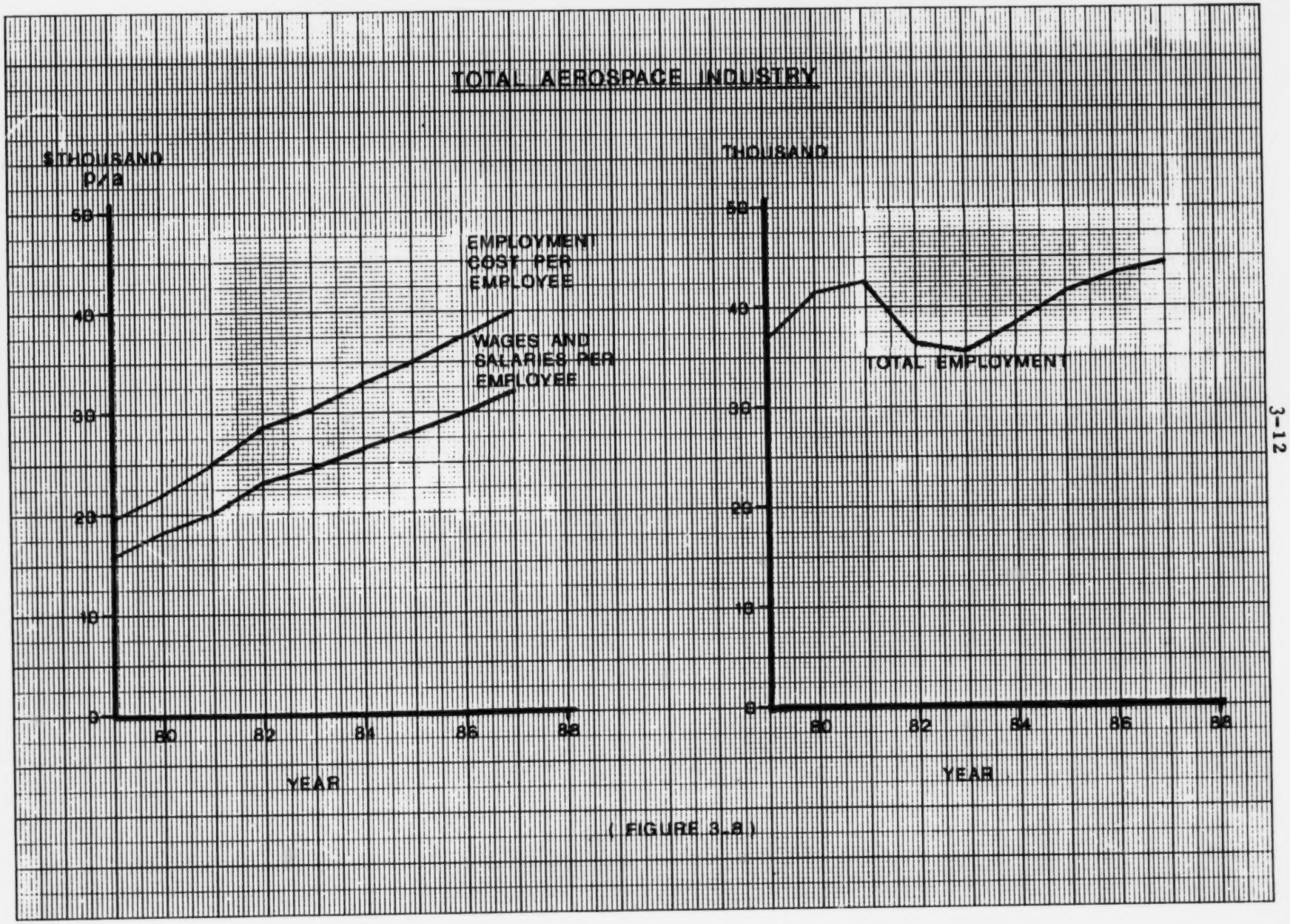
	Per Cent
airframe	30
engines	22
avionics	19
space	13


INDUSTRY VALUE ADDED
$ BILLION
6
5
4
3
2
1
0
GROSS SALES
VALUE ADDED
GROSS MATERIALS & SUPPLIES PURCHASED
80
82
84
86
88
YEAR

(FIGURE 3.6)

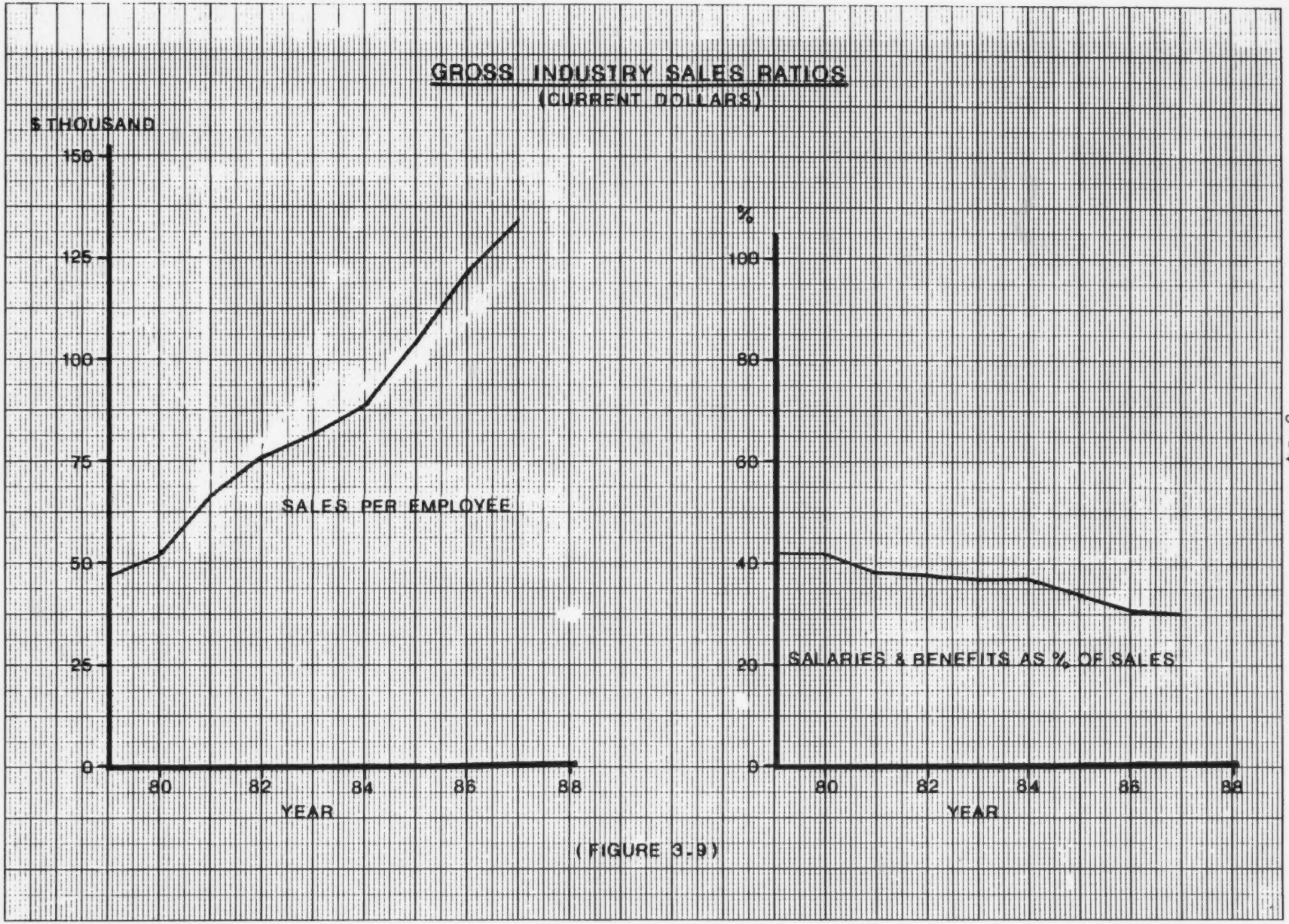

ANNUAL INVESTMENT
(PLANT, MACHINERY, R&D AND EQUIPMENT)
$ MILLION
600
500
400
300
200
100
0
TOTAL INVESTMENT
TOTAL
R&D
80
82
84
86
88
YEAR

(FIGURE 3.7)


TOTAL AEROSPACE INDUSTRY
$THOUSAND P/A
50
40
30
20
10
0
EMPLOYMENT COST PER EMPLOYEE
WAGES AND SALARIES PER EMPLOYEE
80
82
84
86
88
YEAR
THOUSAND
50
40
30
20
10
0
TOTAL EMPLOYMENT
80
82
84
86
88
YEAR

(FIGURE 3.8)

Figure 3.9 shows, however, that this increase is more than compensated for by increased productivity. The dollar value of sales per employee for the industry as a whole is expected to grow at an average annual rate of 12 per cent, while employment cost as a per cent of gross sales is expected to decline from 38 per cent in 1982, to 30 per cent by 1987.


GROSS INDUSTRY SALES RATIOS
(CURRENT DOLLARS)
$ THOUSAND
150
125
100
75
50
25
0
80
82
84
86
88
YEAR
SALES PER EMPLOYEE
%
100
80
60
40
20
0
80
82
84
86
88
YEAR
SALARIES & BENEFITS AS % OF SALES

(FIGURE 3.9)

4. DEVELOPMENTS WITH SIGNIFICANT IMPLICATIONS FOR CANADIAN AEROSPACE INDUSTRY

In the foregoing section, the present (1982) Canadian Aerospace Industry was assessed as well as the industry forecasts through 1987. As noted, the figures utilized were aggregated into the major aerospace sectors, within which a number of smaller, but significant events could be occurring. The Committee therefore solicited a number of briefings from representatives of industry, labour and user/services groups, in order to obtain some better understanding of how the various industry sub-sectors viewed the future, as well as the views of other interested parties.

In total, over forty individual briefings were received involving a wide spectrum of individuals from the above groups, with a correspondingly wide-range of subjects. The purpose of this section is to try to take the macro-picture of the previous section and develop it further as a result of the more detailed picture obtained during the briefings.

Since the briefings were, to some extent, unstructured with respect to subject and included both specific products as well as generic material, the Committee has elected to categorize them into the following areas:

4.1 Aerospace Industry
- Basic industry or manufacturers associated with industry.

4.2 Aerospace Skilled Human Resources
- IAM/UAW, Federal and Aerospace Human Resources Committee.

4.3 User/Services
- Department of National Defence (DND), Dept. of Supply & Services (DSS), Defence Programs Branch (DPB).

4.4 Institutional
- World Product Mandate (WPM), Research & Development (R&D), Defence Industry Productivity Program (DIPP), Product Financing and Powered Lift.

The following sections contain a synopsis of the views expressed within the above briefing categories which appear relevant to the Committee. In particular, the problem must be addressed which is raised by the fact that the forecasts of Section 3 are, to a large degree, unconstrained e.g. all necessary things required to allow them to come to pass are available. In other words, financing is available as needed, DIPP funds are plentiful, market shares are undiminished etc. Since this is not the real world situation, the Committee has endeavored to extract from the briefings not only the views of the future, as seen by each category, but also the constraints which can be determined now or which are foreseen in the future. It is in the area of perceived constraints that future Government co-operation may be most useful and these will be examined in detail in subsequent sections of the report.

The Committee believes that the briefings were a key element in the development of this report since they enabled the views of a large and representative cross-section of the Canadian aerospace community to be heard in a "peer group" environment.

4.1 Industry

A total of 25 briefings were received from the industry, of which seven could be categorized as major transport aircraft oriented (A-320, et al) and one was concerned with the potential helicopter program.

In view of the interest of the Minister of these major aircraft programs, they will be discussed later under Section 5 of this report.

The remainder of the industry briefings were further segregated into sub-sectors as follows:

- 4.1.1 - Commercial Aircraft
- 4.1.2 - General Aviation and Utility Aircraft
- 4.1.3 - Commercial & Military Aircraft Subcontracts
- 4.1.4 - Military Aircraft
- 4.1.5 - Aircraft Repair and Overhaul
- 4.1.6 - Surveillance Systems and Missiles
- 4.1.7 - Engines
- 4.1.8 - Engine Repair and Overhaul
- 4.1.9 - Avionics and Electronics
- 4.1.10 - Satellites and Ground Stations
- 4.1.11 - Simulators

These categories do not correspond directly to any Dept. of Regional Industrial Expansion (DRIE) or other segmentation, but they do relate to the present structure of the industry, with the possible exception being the second-tier component manufacturers, who were not directly represented.

The third-tier support industry was also not discussed directly since the business activity of this level is largely a function of the larger sub-sectors.

4.1.1 Commercial Aircraft

At the present time the only manufacturer of commercial aircraft, as defined by the Committee, is de Havilland Aircraft (DHC) with the DHC-6 "Twin Otter", the Dash 7 and now the Dash 8. Because de Havilland does cover a wide segment of the short-haul air transport industry, particularly outside Canada, it is particularly sensitive to the competitive and economic environment.

As indicated in Section 3, the commercial aircraft sector, which includes all commercial, i.e. non-military aircraft products, is forecast to be the most rapidly growing of any major group.

With respect to the markets represented by the above products, the following points were noted:

a) Twin Otter (20 seat class) -

   i) A very competitive market with new technology products such as Dornier 228, Beech 1900 and British Aerospace Jetstream now entering, adding to seven current competitive products.

   ii) The life of present Twin Otter, of which over 800 produced, is limited.

   iii) The market for 20 seat aircraft is forecast to grow much slower than in past and segmenting between "bush type" or utility and commuter aircraft.

iv) Based on above DHC do not appear to have decided on a follow-on to DHC-6. It is DHC current thinking that a new aircraft in this category would have to offer substantial improvements.

v) In performance and cost based on new technologies, the greatest potential improvement will come from a new engine in the 700-900 horsepower class having fuel efficiencies the same as the P&W 120 or better. It appears no such engine is so far planned in Canada or elsewhere. Further, there is a view that a launch period in 1985-1987 would be seriously jeopardized by availability of used Twin Otters and similar aircraft in this time period.

b) Dash 7 (50 seat class)

i) Competition from Fokker F-27, BAe 748, and ATR 42 (new technology). Also potential competition from BAe ATP project.

ii) Only STOL aircraft is Dash 7, and the development of Separate Access Systems using stub runways is being pursued.

iii) DHC forecast for market of approximately 600 aircraft of this class from 1982 to 1992 and Dash 7 has currently penetrated to extent of 90 sales.

iv) A production rate of one aircraft per month is equivalent to approximately 1,450 Canadian jobs on an annual basis.

v) A stretched Dash 7 of approximately 70 to 80 seats being studied to match competition.

c) Dash 8 (30-40 seat class)

i) Designed to fill commuter market gap between 20 seat and 50 seat class aircraft.

ii) DHC one of first into market which is now crowded with new entrants.

iii) Primary competition from Saab Fairchild 340, ATR 42, Embraer 120, Casa Nurtanio 235 and Shorts 360.

iv) No specific market forecast revealed for Dash 8 but other data available indicates the market could be up to 2000 units for the class between introduction in 1985 and year 2000.

v) A sales rate of four aircraft per month for the Dash 8 would support about 6,000 total Canadian jobs, on an annual basis.

vi) Over a fifteen year period DHC share of market would have to average about 36 per cent of the total, which could be attainable given competitive sales financing.

vii) DHC has a pre-eminent reputation in this market area, and a solid existing base of Twin Otter and Dash 7 customers. Expanding on this, the Company should be capable of achieving a better than average share of the market for the Dash 8 class aircraft.

viii) Major market is U.S., which should improve with economic recovery.

d) Other Products

i) Other than possible derivatives of Dash 7 and 8, DHC has identified no new specific products to the Committee, in the complete aircraft sector, for the short and medium term.

ii) R&D is continuing on the use of powered lift principles for Short Take-Off and Landing (STOL) & Vertical Take-Off and Landing (VTOL) transports.

iii) Application would require sharper role definition as well as partner to share R&D costs and provide markets.

iv) The Company has underway a Phase A study of a large Transport aircraft using the powered lift technology. It is exploring potential teaming with industries from NATO countries on the further R&D and Marketing of an aircraft with C-130 or greater capability. If successful these explorations could lead to a major new program later in this decade.

e) Observations

i) In view of the highly competitive market for the Dash 7 and 8, it will be necessary for DHC to invest a considerable amount in product improvement if it is to maintain its commercial market share. Derivatives are common to all successful civil aircraft programs and, in this case, will be primarily in area of "stretches" and new applications.

A stretched Dash 7 of 80 seats is estimated to cost in the order of $100 million in development to certification. Preliminary estimates show a good rate of return and a break even occurring with the sale of less than 100 units.

The stretched version of the Dash 8 can be developed to seat about 50 passengers and this development program could also enhance sales of the aircraft in the military maritime reconnaissance and corporate markets. This broader market base is forecast to increase total Dash 8 sales by 40 per cent. The additional development cost for the derivative program, depending on content, would be of the order of $50 to $100 million.

ii) Sales financing is a basic problem well known to the Government. If competitive rates are not established by the Export Development Corporation (EDC) then the forecast DHC market share will inevitably drop. Present production plans are based

upon financing being available, so present market share assumptions could be optimistic. Domestic financing also remains a major problem for sales in Canada.

iii) An interesting point was made on the negative effect that Canadian Capital Cost Allowance has on sale of new aircraft to small Canadian carriers and which encourages entry of used aircraft.

iv) The level of funding available under DIPP was considered of major significance and is discussed further in a separate section of the report.

v) The Enterprise Development Board program has been utilized for the guarantee of loans to U.S. operators however, in view of the competitive financing available elsewhere, it should re-examine its terms.

4.1.2 General Aviation and Utility Aircraft

Under the category, Canadair is essentially the only supplier with the Challenger series and the CL-215 water bomber. The summary of the Committee on these programs is noted below:

a) Challenger 600/601

i) Canadair is well positioned in the large aircraft segment of market as a result of high certification standard and increasing visibility of the Challenger aircraft in the market place.

ii) Primary competition in the top end of the line to the CL-601 appears to be the Gulfstream Aerospace G-III and G-IV and the recently announced Falcon 900. The CL-600 competes over the medium range with a greater number, including the Cessna Citation III, G-II (used), BAe 125-800 and Falcon 50. Used airline aircraft are also a source of competition.

iii) The overall market forecast for the CL-601 type aircraft over the next five to ten years is presently under review by the new owners of Canadair, namely CDIC, however in view of the recent announcements by the competition with respect to new derivatives, the long term market for large business aircraft appears to be sound.

iv) As a result of the negative publicity recently received by Canadair and the Challenger program in the Canadian media, the share of the overall market which might be achieved by the Challenger is under review.

v) The Committee believes that the CL-601 is, and will remain, very competitive within the large business aircraft class, however a positive statement as to their long term commitment to this program must be made by CDIC and/or the Government as soon as possible. Any perceived uncertainty in this area can only harm the program and make the required market share unattainable.

vi) the CL-600/601 could be responsible for between 2,100 and 3,700 annual jobs over the production period, assuming that appropriate derivatives are developed as required.

b) CL-215 Water Bomber

i) The Federal Government under the Special Recovery Capital Program proposes to purchase 20 Water Bombers for $147 million, provided that the provinces purchase 16 additional units.

ii) Competition is primarily used aircraft either from World War II or converted airliners, none of which are as efficient as "water scooper".

iii) Continuation of line to build domestic aircraft on a shared basis between Federal/Provincial governments should enable additional aircraft to be sold in export market.

iv) Canadair would plan on 10 aircraft per year for five years which would maintain about 500 jobs.

c) Observations

i) For Challenger, problems are primarily in the market and not under the Canadian Government influence or control.

ii) Because of costs, any future large aircraft would probably have to be developed within a consortia.

iii) The CL-215 program is in danger of being closed down unless the recent Special Recovery Program initiative is followed through; this would affect not only aerospace industry but the protection of Canada's forest resources.

iv) Sales financing is a problem for the CL-215 however, it would benefit from any improvement prompted by DHC.

v) Canada produces very few indigenous general aviation aircraft other than the above. Because of wide variety of GA aircraft used, there appears to be little prospect for Canadian production, with possible exception of helicopters discussed later.

4.1.3 Commercial and Military Aircraft Subcontracts

The total subcontract market has grown from about $18 million revenue in 1973 to a total of $78 million in 1982, (excluding Canadair). Over the 10 year period the sector produced total sales of $657 million (including Canadair) with export sales of 77 per cent and commercial sales 57 per cent of total.

a) Subcontract Sector

i) Primary subcontractors are Fleet Industries, Bristol Aerospace, Enamel and Heat, Canadian Aircraft Products, Boeing of Canada and Canadair. These firms and other smaller ones bid on and receive work from other major OEM's.

ii) The above group provided a total of 20,000 man-years of employment on subcontracts over 10 years. In 1982 the employment was estimated to be in the order of 2,600. The sector has a high value added element.

iii) A major subcontractor not included in the above group is McDonnell Douglas of Canada which, as wholly owned subsidiary of McDonnell Douglas Corp., is the sole source for DC-9 wings and empennage (25 per cent of structure weight) and DC-10 wings (13 per cent of structure weight).

iv) Over past 15 years McDonnell Douglas of Canada has produced sales of $2.11 billion, making it a major factor in the Canadian industry. Today the company employs about 2,100 persons and is producing one DC-9 unit per week.

v) McDonnell Douglas of Canada subcontracts about 30 per cent of DC-9 work to other Canadian firms. Also the parent corporation has purchased over $500 million from Canadian firms for other programs, such as A-4 and F-15. The effect of future programs is discussed later.

vi) The other major commercial program is the Boeing 767 rear fuselage manufactured by Canadair. This program is expected to provide 350 jobs for the next 5 years.

vii) Significant commercial subcontracts have been let by both DHC and Canadair on the Dash 7 and 8 and Challenger programs, respectively.

viii) On military side the P3C wing program at Canadair, the cockpit section at Fleet, and other components at Enheat and IMP are employing about 1,500 persons and which could go on for the next five to ten years.

ix) Offset work connected with the CP-140 program accounted for the bulk of the $324 million of subcontract work over the past 10 years, with F-18 work starting to become significant in the total. Estimated component production in Canada for the F-18 is in the $35,000,000 range annually.

x) The only new major program seen at this time is the C-5B work won by Canadair. This starts in 1983 and will produce about 2,300 man-years of work over the next 5 years.

b) Observations

i) Lack of new, indigenous Canadian programs makes a number of subcontractors vulnerable to pull-back of work by foreign OEM's.

ii) A strong belief by subcontractors that the F-18 work is not materializing as expected in terms of new jobs.

iii) Increasing complexity of structures (CAD/CAM, NC machinery, composites) requires plant modernization and increasing access to DIPP.

iv) In case of McDonnell Douglas of Canada, they would like some form of Domestic EDC financing (or equivalent) so that major components of DC-9 and 10 meet financing (Exim, or COFACE) put forward by manufacturers from outside Canada, who produce no part of aircraft here.

4.1.4 Military Aircraft

The production of complete military aircraft has virtually ceased with the exception of the de Havilland DHC-5 Buffalo, which is planned for production at a rate of 10 aircraft per year for the next few years. This program will maintain approximately 600 jobs at de Havilland.

The only future Canadian military aircraft purchase would appear to be a new trainer for the 1990's, but no information is available on this program.

Observations:

i) DND has no specific mandate to support development of aircraft in Canada.

ii) The Government has had no success in selling complete Canadian aircraft as part of offsets program.

iii) Limited systems capability in Canada as result of DND policy.

iv) Sea King replacement will probably be purchased offshore but attempts will be made to maximize Canadian avionics systems.

v) Little military aircraft R&D in Canada performed by industry as a result of (i); therefore limited advanced technology acquired.

vi) Military market can be counter cyclical to commercial, but Canadian industry now largely commercial, except for offsets. Military proportion estimated to be about 20 per cent.

vii) The loss of FATIC (Final Assembly and Test in Canada) for the CF-188 is seen by industry to have reduced Canadian capability for any future, complex, aircraft program, and has resulted in a loss of technology transfer.

viii) Opportunities may exist for Canadian participation in U.S. V/STOL programs, particularly with JVX tilt-rotor and powered lift programs, however this would require quick action by Government.

4.1.5 Aircraft Repair and Overhaul

In 1982 the total sales of aircraft repair and overhaul work, including engines, was about $267 million, of which the airframe, avionics and other components comprised about $100 million or the equivalent of approximately 850 jobs.

The total work effort in 1982 was divided about equally between military and commercial, however the balance is expected to swing towards the commercial activities in the future. In 1986 the forecast of sales in the aircraft R&O sector excluding engines is $167 million while employment would increase slightly to about 1,000.

While the sales in this sector are relatively modest it does provide a necessary, underlying business base for a number of smaller aerospace firms. Factors influencing this sub-sector are as follows:

i) Greater requirements for systems engineering will require increased investment in training and test equipment; the CP-140 and CF-188 are problem areas.

ii) There exists an export market for R&O beyond the U.S., but it is relatively small and usually requires financing.

iii) A major DND market, which is developing, is in the area of modification and reconfiguration, particularly with respect to the helicopter fleet.

iv) Firms in R&O are well dispersed across country and can respond quickly to regional diversification programs from government.

4.1.6 Surveillance Systems

Unmanned surveillance systems are very advanced technology and Canada is recognized as a leader in the field. The primary industry member is Canadair and other participants are Bristol, Irvin Air Chute, Canadian Marconi and Aviation Electric. Major program elements are discussed below:

a) CL-89

i) Continued operational success has lead to greater acceptance. The latest Middle East conflicts have increased interest in drones and RPV's (Remote Piloted Vehicles).

ii) A large potential for RPV's and drones seen in non-Warsaw pact countries, but CL is limited at present to NATO and some selected allies.

iii) Sales of CL-89 have risen to $187 million by end of 1982, and are forecast to rise to $320 million by 1995. This program will utilize about 1,100 person-years over the period.

iv) The original Canadian government investment in the program was $12 million (plus $24 million for U.K. and FRG).

b) CL-289

i) A more advanced version of the CL-89 which has been funded 25 per cent by Canada and 75 per cent by FRG.

ii) The accompanying work agreement gives Canada 50 per cent of effort.

iii) The current customer planned sales and forecast to be $342 million by 1988, up from $57 million in 1982. Other customer potential is estimated to be $200 million.

c) CL-227

i) The CL-227 is still in the early development stages however, based upon sales to-date of $4 million, Canadair is estimating $167 million by 1987.

ii) By year 2000, a total of 4,000-5,000 air vehicles and 400-600 operating stations are predicted with a value of over one billion dollars

iii) Competition for this market is from Israel and U.S.

d) Observations

i) Assuming the Canadair sales forecasts to be reasonable, by the end of 1987, the cumulative sales for all three systems will have reached in excess of $700 million approximately in 1983 dollars, and is almost completely export. This compares very well with some aircraft programs with much larger development costs.

ii) A program such as the CL-227 could probably generate some commercial spin-off in terms of use of technology e.g. traffic control, police work etc.

4.1.7 Engines

The largest aircraft engine manufacturer in Canada is Pratt and Whitney Canada (P&WC), which last year employed about 6,500 people. In 1981, the company had revenues of $770 million, with 80 per cent of total sales being export; if DHC export shipments are also included, P&WC's export percentage approached 85-90 per cent.

To proceed from a branch plant based on aircraft piston engine business in 1961, to the 1981 company, which had achieved an internationally dominant position, (40 per cent of world civil small turbine sales) has required a heavy dedication to R&D. The cumulative total in product development was about $680 million at the end of 1981 of which about $190 million was government funded.

All major industrialized countries strongly support their aerospace industry by direct ownership, domestic procurement policies, or as in the U.S. through national defence procurement needs where all development, start-up and manufacturing costs are paid for with profit. In Canada, P&WC must not only have to repay its government support but, it must also face the competition of commercial spin-off of these military engines, e.g. the commercial CT-7 engine spin-off of the military T-700 engine.

P&WC sees its market for the PT6, JT15 and PW100 series of engines to be in the Regional Transport (Commuter), Corporate Turbine and Civil/Para Military and Helicopter Markets.

a) Regional Transport

i) Forecast of sales for aircraft in this market, which would extend from the smallest P&WC powered aircraft up to the 60 seat size, are in the order of 3,200 aircraft.

ii) It is expected that about 70 per cent would have P&WC power or 2,200 units. Since most of the aircraft are twin-engined, the total engine sales to this market would be a substantial 5,300, including spares, for the 1983-1992 time period.

b) Corporate

i) In this market P&WC expects a total of 14,000 aircraft of which about 65 per cent or 9,100 aircraft are expected to be P&WC powered.

ii) Based on the major application being the twin-engined aircraft, this market could represent over 20,000 engines.

c) Helicopters

i) The total forecast of helicopters of all sizes in the 1983-1992 period is about 14,700 units.

ii) P&WC market share is not forecast to remain relatively constant, as for the fixed-wing but decrease from about 15 per cent in 1982 to around 5 per cent or 100 installations in 1992. A strategy is being formulated however to arrest P&WC's declining sales and market share.

d) Other Manufacturers

In addition to P&WC, there are three other aircraft turbine engine suppliers of either complete engines or major subassemblies; these are Rolls-Royce Ltd., Orenda and Canadian General Electric.

While the Committee received no briefing from these firms, it is known that they are currently providing components to OEM's and auxiliary power units. They

are also largely involved in R&O discussed below, but manufacture components and assemble a number of industrial turbine units for standby power and pipeline applications.

f) Observations

i) P&WC plan to invest some $360 million in R&D from 1981 to 1983, of which about 28 per cent or $100 million is expected to be government supported.

ii) In addition to the investment in R&D, the company is investing heavily in the area of "Flexible Manufacturing" where the increased automation leads to major improvements in both production efficiency and inventory turnover.

iii) Because of the amount of competitor R&D as well as facility modernization funded from military development, this type of investment is essential if they are to produce the engines forecast.

iv) P&WC has a world product mandate and a world class product as evidenced by its market domination in the regional transport and corporate market, for turbine powered aircraft. Opportunities exist within the civil helicopter industry which may warrant additional investment in R&D.

4.1.8 Aircraft Engines Repair and Overhaul

The repair and overhaul of high technology turbine engines is found in the companies noted in the previous section namely, P&WC, Rolls-Royce, CGE and Orenda as well as Standard Aero Ltd. and Garrett. The latter facilities do not do any manufacturing at this time.

In addition to the industry companies, both Air Canada and CP Air overhaul a range of commercial turbofan engines; with only Air Canada doing the high-bypass, high thrust engines.

The size of the engine R&O business is difficult to assess however, as noted earlier, the industry estimates sales of $167 million in 1982, split about equally between military and commercial; which would be equivalent to about 1,500 jobs. It is forecast that engine R&O will grow to sales of about $225 million in 1987 and employing about 2,800 people.

The support of the DND fleet by local industry provides the firms with a significant base from which to pursue other business.

There are a number of factors which will affect this sector in the future:

i) General engine design improvements through modularity, on-condition maintenance, computerized troubleshooting etc. will mean that engine maintenance costs will be reduced.

ii) High technology engines require more expensive repair and test equipment which limits number of facilities which can support costs.

iii) Competition for independent R&O shops is becoming intense internationally due to formation of airline consortia to handle maintenance.

iv) Significant reduction of DND base business if Air Canada obtains overhaul of F-404 engine.

4.1.9 Avionics and Electronics

The five companies most active in aerospace avionics and electronics are:

- Canadian Marconi, Montreal
- Computing Devices, Ottawa
- Garrett Manufacturing, Toronto
- Leigh Instruments, Ottawa
- Litton Industries, Toronto.

There are approximately 8,000 people employed in this segment of the industry which is in a high technology, highly competitive, export oriented market. In this international market, each Canadian company would be considered small. The following points were noted:

i) The products of this sub-sector (see Appendix A) are considered to fall into the high technology area and are characterized by large development costs and a reasonably lengthy marketing cycle. This demands the availability of financial resources throughout the innovative process of research, design and development of the product, and manufacturing tools and test equipment to get the product to market. Foreign competitors are able to attract a higher percentage of

government assistance (quite often up to 100 per cent) than do firms in Canada, placing a heavier financial burden on the Canadian companies.

ii) High technology products are always advancing in the state-of-the-art and access to the newly developed componentry and technology therefore is an essential element to continued success. Recent developments in the U.S.A. restricting this access on such things as:

- very high speed integrated circuits (VHSIC)
- electro-optics data
- nuclear hardening of components/systems data.

are of significant concern to these companies. A government to government discussion could be useful in eliminating some if not all of these restrictions.

iii) Countries with a significant military aircraft manufacturing capability tend to fund R&D of their own industry at a very high level. The U.S.A., France and Japan are making major increases in R&D for their military requirements. Since Canada does not have a military aircraft manufacturing activity, this heavy R&D funding is not available from DND. Also, since the procurement is for an "off the shelf" airplane, it is often too late to get on-board even if funding were available. The avionics and electronic companies are looking for funding assistance to get on-board these offshore vehicles at their inception. This is usually long before any Canadian decision to buy is made.

iv) The industry competitive strategy has been and must continue to be:

- to establish Canada as competent suppliers of a product or products that have a "niche" for which a world-wide market exists,

- to be constantly aware of the need to improve productivity through use of computer aided engineering (CAE) computer aided design and manufacturing (CAD/CAM) robotics, etc.,

- continue to up-grade skills of the work force.

v) A significant change in the avionics market sees the mammoth electronic firms such as IBM and ITT/Hughes taking over the prime contractor role. This could present real dangers for Canadian avionics and electronic firms if these primes decide to take on a larger electronic role in-house. Canadian government and industry should be looking at the possibility of fostering Canadian firms into systems integration to counter this threat.

vi) Since avionics really means airborne electronics, it utilizes all electronic technology, which has a very wide capability to be spun-off into non-aerospace applications. This provides a hidden return on avionics R&D. A good example of this is Canadian Marconi, who have developed two new businesses in the past three years, each of which is larger than their initial avionics group.

vii) The world-wide avionics market over the next decade is in the billions of dollars. Products developed by the spin-off of technology would probably exceed that for avionics.

viii) It is important to this sector that the government takes action with foreign countries which will continue to permit access to these markets and refrain from taking action at home which might cause a negative reciprocal action by foreign primes or governments.

4.1.10 Satellites and Ground Stations

The application of space technology is increasing at a very high rate in Canada; particularly in the areas of communications and remote sensing. Both of these areas can have a significant impact on the economy through improved communications, data transmission, exploitation of resources, navigation, weather forecasting, surveying and ecological pollution. Communication and remote sensing are expected to be areas of high world-wide commercial growth over the next two decades.

In 1982, the industrial side of the space industry employed over 2,300 persons and had sales of $182 million, of which 62 per cent were exports. The sales per employee were a very impressive $78,000.

Spar Aerospace is the largest company in this segment of the industry with almost 2,000 employees in 1982, some of whom were involved in non-space divisions. Altogether, there are about 38 firms involved in the space program to a greater or lesser degree including the service companies such as Teleglobe.

Some observations on the material presented is shown below:

1) The world market for communications satellites is estimated to be in the order of 155 units from 1983 to 1992. In addition, a total of 33 remote sensing satellites are forecast to be procured in the same interval, for an estimated total value of $13.8 billion U.S. Another $2.3 billion of military purchases are anticipated for the period leading to an expected total of $16.1 million.

2) Based upon the market share of the Canadian firms in 1982 of about 8.3 per cent of the space market, when some $900 million in satellite orders were signed, and if the average annual market is $1.6 billion per year, then Canada could hope to receive about $133 million/year in satellite communications work.

3) Since the ground stations are estimated to require about equal investment to the comsats, a potential ground station business of $133 million per year can also be foreseen.

4) The total jobs which this level would sustain would appear to be in the order of 4,200, which would make space a major factor in the industry.

5) It can be concluded that the space program is an industry of major significance that is in its early growth phase. The market is expected to mature in the 1990's and, to ensure Canadian presence in the field, it was recommended that the industry:

   i) be assured of preferred access to the domestic market.

   ii) maintain continued access to DIPP, PEMD and similar programs.

   iii) receive specialized marketing support abroad from the government since most customers are governments or their agencies.

6) The space industry is R&D intensive, and the existence of a viable industry, capable of fully exploiting export opportunities, requires that there be a continuous domestic space program with at least one major space project in the build phase at all times.

4.1.11 Simulators

While this subsector could have been included with Section 4.1.9, it is by itself sufficiently unique and important to be examined separately. The only company in Canada producing this very sophisticated equipment is CAE Electronics Ltd.

The company has 1,750 employees and has annual sales in the area of $100 million. In view of the technology requirements of their products, 665 of the employees are engineering, scientific and technical or 38 per cent, while 23 per cent are classified as skilled

production workers and 10 per cent unskilled. Administration makes up the remaining 29 per cent.

Within its product lines the company manufacturers the following:

- flight simulators and training devices
- power station simulators and training devices
- supervisory control and data acquisition devices
- magnetic anomoly detection systems
- ATC display systems
- remote manipulator subsystems

The flight simulator sector is the largest area of activity and this market is split 50/50 between military and civil, with the main market Western Europe. Exports account for 60 per cent of the sales.

Simulators have been produced for a wide range of military helicopters, tactical aircraft and transports, as well as for all major commercial aircraft, including the Canadair Challenger.

The Commercial simulator market is currently in difficult times as is most of the transport aircraft business.

The simulator industry problems identified are rather similar to those of the Avionics sector.

i) Analysis of sales performance indicates:

- Canada has leadership in technology.
- Achieved significant market share (35 per cent) when interest rates low (1978-1980).
- British increased market share in 1981 and 1982 as a result of better financing and devalued pound.
- French aircraft contracts had benefits for Thompson CSF built in.

ii) Proposed company action to regain position:

- Continue to advance technology through Phase III systems
- Cost reduction programs on current products
- Computer aided manufacturing to meet high production requirements for printed circuits.

iii) Proposed Government action to assist:

- Increased R&D funding through DIPP program.
- Improved EDC financing including firm financing up front in offers, financing even when no off-shore competition involved and participation in sales programs.
- Inclusion of simulators in any future offset program or major program participation.
- Resolve anomaly in duty and FST which favours foreign simulators in Canadian market.

4.1.12 Powered-Lift Technology

Two of the ongoing research programs in Canada today relate to powered-lift technology, as exemplified by the augmentor-wing, and ejector-lift concepts.

The augmentor-wing concepts use a split-flow engine to direct engine air flow to a ducting system along the trailing edge of the wing, which is directed through a split-flap arrangement to provide additional lift.

The ejector lift concept, in addition to the lift augmentation system, uses vectored thrust to provide additional lift for take-off and landing.

The augmentor-wing concept is being developed for the Advanced STOL Tactical Transport, and the U.S. Navy V/STOL Support Aircraft, while the ejector-lift concept is being proposed for the joint USAF/USN/NATO Supersonic V/STOL Combat Aircraft. De Havilland Aircraft are involved in both of these programs.

If Canada is to play any significant part in this new technology then major funding would have to be provided, presumably under some shared program with the DOD.

4.2 Aerospace Skilled Human Resources

In view of the forecast expansion of the industry, as assessed in Section 3, the question of the availability of skilled Human Resources is important. It should be noted that the aerospace industries have been in the forefront of human resource planning and the AIAC has had a committee on the subject for the past ten years. The government's position that industry is responsible for acquiring and retaining the human resources it requires, has been well accepted.

To establish the human resources requirements/ training environment in Canada, the Committee received briefings from the IAM&AW, Dept. of Employment and Immigration and AIAC Human Resources Committee. A number of observations was made on these presentations as follows:

1) The Canada Employment and Immigration Commission (CEIC) is fully aware and supportive of the steps taken by Industry and Labour to determine the job requirements and skill levels necessary to achieve the growth objectives.

2) The development of CAMAQ in Quebec, Ontario Aviation Group and the Western Aviation Group in Manitoba with the ability to conduct surveys of supply/demand, identify potential bottlenecks and design training and other human resource development measures, has gone a long way in assisting the aerospace industry.

3) In addition to the forecast of skilled workers the industry should not lose sight of the professional personnel required if the industry is to maintain its competitive position: The CCPE is now developing an up-to-date engineering inventory.

4) The Canadian Occupational Projection System (COPS) is now in operation and is considered a

major forecasting tool for identification of the supply and demand for workers by occupation and by province. This system should be supported by the aerospace industry.

5) A review of the fourth annual survey of manpower needs in the Ontario aerospace industry covered the actual employment activities from January 1981 to January 1982 and projection to January 1986. This information provides a benefit to the participating companies as well as CEIC and other Federal/Provincial bodies. Eleven firms representing 90 per cent of the Ontario aerospace employment were involved and the survey covered 54 occupations.

6) Even with a reduction in new hirings, the industry is faced with a potential training program covering 13,870 replacement plus 3,593 new hirings or approximately 17,500 workers over the next four years. There are a number of caveats in these figures, however the training load could be significant, particularly in the light of new technology industries.

7) Advantage should be taken now of the flat spot in the industry to begin active training programs with the objective of upgrading skills where demand is apparent, namely electronics area and assembler jobs (airframe and engines).

4.3 User/Services

In this section the main thrust of the briefings are from what have been categorized as either a user of aerospace industry products or service agencies, which provide assistance to the industry. Three briefings were received in this group as follows:

4.3.1 Department of National Defence

A review of all the major aircraft programs was presented including an overview of Fighters, Transports, Helicopters, Simulators, R&D and Space projects. Because of the extent of the briefing it is not possible to more than touch on the most salient items in each category:

a) Fighters

i) T-33 DLIR is to be undertaken this year.

ii) CT-114 Tutor replacement is planned for option analysis in 1986-1987.

iii) CT-134 Muskateer will be retired end of 1980's.

iv) CF-188 various modification projects underway.

b) Transports

i) CC-109 Cosmo considered for replacement in 1989-1990.

ii) CC-115 Buffalo replacement is being considered in 1989-1990 period.

iii) CC-144 Challenger requirement for two more aircraft is indicated in 1983-1984.

iv) CP-140 Aurora up-date being planned for 1987/1988.

c) Helicopters

i) CH 136 Kwowa mid-life up-date (MLUP) being considered, also possible participation in AHIP is being examined with 50 per cent Canadian content. Possibly $250 million involved with 50 per cent spent in Canada.

ii) CH 135 Huey, MLUP planned with cost of $144 million with 90-95 per cent Canadian content.

iii) SKR (Sea King Replacement), requesting position from industry regarding option analysis.

iv) CH 113 Voyageur composite blade replacement.

d) Simulators

i) C-130 simulator to be replaced 1983-1984.

ii) CF-188 simulator to be procured 1983-1984.

iii) SKR simulators and trainer study in 1986-1987 as part of SKR project.

e) R&D Projects

i) Flight Data recorders - two to three types needed in period 1985/1986 through 1989/1990.

ii) SKR or SKLE has requirement for R&D in wide variety of areas commencing 1983/1984.

iii) CP 140 up-date, including new spotlights.

iv) Sonobuoys for SKR, SKLE and CP-140.

f) Space

i) Considerable effort in number of international programs particularly communications, Navstar and Sarsat.

ii) Purpose is to keep DND familiar with all major programs, both U.S. and NATO.

iii) Total funding over 1983/1985 is in order of $50 million.

g) Other

In addition to above programs DND has a number of other programs which it would like to take the initative upon such as:

i) Weapon systems support for CP-140, CF-188.

ii) Weapon systems software support capability.

iii) System Management Engineering for CPF as well as SKR and CP-140.

iv) Low level air defence, which might generate offset work, valued at $900 million.

v) Sea Sparrow improvement/replacement program.

vi) Weapons for Canadian Patrol Frigate (CPF) including surface-to-surface and surface-to-air missiles.

h) Observations

i) It was not possible for DND to state which of the programs discussed were considered firm and which were potential, because of the lack of firm long term budgets.

ii) In terms of top priority, DND is focussed on the CF-188 introduction and the CPF program.

iii) The question of the role of DND in supporting Canadian industry was discussed but will be dealt with in a broader context in subsequent sections.

4.3.2 Department of Supply and Services (DSS)

The role of DSS as the procurement agency for the Government was explained and, in particular, the approach adopted by DSS to the aerospace industry. To illustrate the two basic elements of DSS policy, namely "Buy Canadian" preference and "Equal Opportunity" for Canadian suppliers, a number of examples were cited:

a) Procurement Initiatives

i) Limit competition to Canadian suppliers only when two or more exist.

ii) 10 per cent premium can be paid for Canadian supply.

iii) Procurement Review Committee (PRC) reviews all contracts over $2 million and ensures maximum Canadian content if foreign supply unavoidable.

iv) New profit policy which rewards contractor in accordance with Canadian content, general business risk, contractor's risk, capital employed.

v) Source Development Fund (SDF) with $10 million plus $20 million commitment level, established to improve product innovation, increase Canadian content, and to cover "front-end" development costs; administered by DSS.

vi) Unsolicited Proposal Program (UP) budgeted at $28 million in 1982/1983, plus $18 million commitment, to permit rapid responses to unsolicited proposals from private industry in support of government science and technology objectives.

vii) Joint Development Programs such as surveillance drones, where DSS provides project management to foreign governments at no charge.

viii) Licensed production in Canada of a number of aircraft and engines.

b) Canadian Commercial Corporation

i) Contracts in order of $500 million per year and much larger expected this year with cruise missile and Light Armored Vehicle.

ii) Sources Canadian (either sole source or competitive) since other governments inviting bids.

c) Repair and Overhaul

i) Objective is to develop Canadian self-sufficiency for military equipment.

ii) Industry provides strong maintenance and support capability in Canada.

iii) Offshore sourcing only used where economics are such that self-sufficiency has to be reconsidered.

iv) Total business contracted in this area is in order of $250 million annually (see Repair and Overhaul discussion).

4.3.3 Defence Programs Branch

This branch is responsible for the development and co-ordination of the defence marketing of the Canadian industry, including aerospace products, to foreign governments around the world. Since the export of Canadian defence products in 1982 was estimated to be $1.46 billion, of which aerospace was about 41 per cent or $515 million, and is expected to increase at an average rate of 26 per cent over the next five to ten years, this is a most significant area for the industry.

In 1982 the world trade in defence products was estimated to be $33 billion of which 45 per cent or $15 billion was aerospace products. The Canadian share was 3.4 per cent of this, which is an increase over the 3 per cent of the previous five years. The maintenance of this level of sales is foreseen to be difficult, in view of the factors discussed below for the major markets.

a) United States

i) About 71 per cent of Canada's defence trade is with the U.S. of which 45 per cent is aerospace.

ii) Current economic and technological protectionism in the U.S. will continue to be a problem.

iii) Recommended that Canadian industry participate in major programs, under DDSA and DPSA, at the earliest stage possible in co-ordination with DND.

iv) Lack of success in selling "end products" must be addressed by industry and government if balance with U.S. in defence trade to be attained.

v) Development of co-operative arrangements viewed as key element in penetration U.S. military market.

b) Western Europe/NATO

i) Sales of defence equipment about $168 million in 1982, of which 55 per cent represented aerospace products.

ii) Joint Research, Development and Production programs on surveillance systems, simulators and engines have been implemented in the past.

iii) Increased interest exists for licensed production of Canadian products in Europe.

iv) Major contracts cannot be won in Europe without co-operation and/or co-production with European firms.

v) Offset requests of up to 100 per cent for business placed in Canada, are now being required by certain countries.

vi) Canadian strategy of pursuing offsets on Canadian procurements is straining relations with some trading partners.

vii) In general Canadian aerospace products are in direct competition with the European products and the room for co-operative ventures exists in relatively narrow niches.

c) Other Regions (Middle East/Africa, South America-Asia/Australasia)

i) This area accounted for 18 per cent of defence sales.

ii) Regional market small but significant in sales of end products.

iii) Problems of marketing aerospace products are:

- Need to provide competitive financing.
- Requirement for local industrial benefits.
- Desire among smaller nations to diversify sources of supply.

d) Observations

i) The industry has done well in selling aerospace defence subsystems and components in the U.S. and Western Europe, and "end products" in other Regional defence markets.

ii) The DIPP program has been responsible for the development of a number of programs which have contributed in major ways to defence sales and any reduction in this program will have a serious effect on defence sales.

iii) The requirements for competitive financing will make the problem of sales in the regional areas more difficult, in view of competition with EDC for funds for non-military requirements.

4.4 Institutional Observations

4.4.1 World Product Mandate

There are many operational modes for Canadian subsidiaries of foreign companies. Three of the most common are:

a) A branch plant whose primary purpose is a presence in Canada to market the parent company products with the minimum of manufacturing and repair and overhaul required to maintain a share of the Canadian market.

These plants provide few jobs and require a minimum investment. Very little if any technology is transferred to Canada.

b) A Canadian manufacturing facility integrated into the multi-national production process but without any or minimal research, design, marketing or sales responsibility. These often are the result of a subcontract or build-to-print operation established as an industrial offset or benefit to attain major programs in Canada.

This type of activity usually provides a much larger contribution to the Canadian economy than does (a) by the way or more jobs, greater capital investment and development of manufacturing technology.

It may also have a greater risk since the stability of the work force is totally dependent on the success of the parent. Canadian management decisions are strongly influenced by factors outside their control.

c) A specialized or rationalized subsidiary that has been integrated into the world-wide plans of its parent by the establishment of designated product lines for which they are responsible for research, design, development, manufacturing, marketing and supporting on a world-wide basis. This has been called a "World Product Mandate".

There are quite a few companies in Canada with a World Product Mandate, of which several are in the aerospace industry.

In general, Canadian subsidiaries with World Product Mandates have performed significantly better than the other operational modes. The reasons for this are reasonably simple to define.

a) The economics of scale of a world-wide market.

b) The development of a technological base from which to grow.

c) Full integration of the organization elements which make the Canadian management team masters of their own destiny and permit them a much greater decision making responsibility.

The results of this form of operations translate to:

1) More long term employment.

2) Employment of highly skilled and technically oriented personnel.

3) Greater use of Canadian sources of goods and services.

4) Assistance in the balance of trade and foreign exchange situations by being very heavily export oriented.

Because of a deeper involvement in Canada by way of investment in manpower, capital equipment and facilities, they are normally more responsive in identifying with Canadian priorities, policies, and the like.

4.4.2 Defence Industry Productivity Program (DIPP)

The Defence Industry Productivity Program operates in support of Canada's co-operative international defence sharing agreements on research, development and production. The program originated in 1959 when the Canada/United States Defence Production Sharing Agreement went into effect. Since then, development

sharing agreements have been negotiated with the United Kingdom, France, the Netherlands, Italy, Sweden, Germany and Norway. These agreements enable Canada to procure major defence systems and supplies abroad at competitive cost, while Canada's economic growth and technological capability is enhanced through the development and production of defence and defence-related products for these markets. The Program provides added opportunities for Canada's industry to compete in foreign defence markets by partially offsetting the financial assistance granted to foreign companies by their governments.

DIPP funds can be applied towards the following type of programs:

- applied research and development of defence-related products
- establishing a Canadian company as a qualified supplier of defence-related products
- modernization projects to acquire advanced production equipment intended for defence-related products
- marketing feasibility studies to establish the specifications and characteristics of a product

Eligibility requirements state that the cumulative sales revenue for the first five years of production should total ten to twenty times the DIPP contribution, with the amount of the contribution (relative to the overall investment) being negotiated individually for each project.

Capital Assistance contributions are not normally repayable; however a repayment program for other DIPP funds are negotiable. Terms for repayment will be a function of overall project ROI.

DRIE believes that the success and longevity of DIPP have been partially attributable to its flexibility, and suggests that its evaluation criteria be interpreted judiciously. A recent study of the program estimated that the overall program ROI has averaged $10\frac{3}{4}$ per cent overall, and $7\frac{1}{2}$ per cent for incremental projects only.

It is clear from the statements of all concerned that DIPP represents an essential, flexible program, which should be maintained. It should be noted, however, that relevant DIPP guidelines (9/81) suggest that greater emphasis be placed on projects using mature technologies, in order to minimize overall risk. This may be a reasonable objective for the private sector, but has the effect of channelling public funds into those areas most likely to be able to develop support from other sources. In a sense, it may be more productive from the point of view of advancing technology, to channel funds to riskier R&D areas, which are less able to compete for dollars on a strictly competitive basis, but may generate less competition on a world-wide basis.

4.4.3 Research and Development

R&D is the most critical element in the maintenance of a viable aerospace industry. Without R&D, there would be no product development, and eventually no new products. The industry would be relegated to "build-to-print" subcontract manufacturing operation; a role with a very limited future. To maintain industrial competitiveness, most[1] successful western countries spend between $1\frac{1}{2}$ and $2\frac{1}{2}$ per cent of their Gross National Product (GNP) for R&D effort.

A recent U.S. report on Aeronautical Research and Technology Policy, prepared for the Executive Office of the President, makes the following key points regarding the relationship of R&D expenditures and government policy, and explains why government participation is required:

- There are commercially attractive investments that may require financial resources that are beyond the ability of individual firms to generate or borrow.

- The benefits of some R&D programs may be so widespread that the specific applications may not be readily foreseen, or the full value of the benefits captured, by individual firms, within the characteristically long time horizons typical of aeronautical R&D investments.

[1] Data for U.S., France, Germany, Japan.

- The results of aeronautical R&D are often knowledge or expertise-based, and therefore, very difficult to patent and protect for very long periods of time.

The study concludes that "a continued strong government-budgeted program of aeronatical R&D...should be maintained. Funding stability is important to the long-term productivity of...aeronautics in particular. This should be an important consideration in developing future aeronautical R&D budgets".

The committee concurs with the above findings, as applied to Canada.

4.4.4 Export Sales Financing

Sales financing has become a vital tool in the marketing of Canadian manufactured aerospace products. For example, in the period 1980-1982 about $439 million export sales were generated through instruments available from the Export Development Corporation (EDC). Further sales financing assistance is available through the Enterprise Development Board (EDB) which provides guarantees for loans made through commercial institutions. It applies to certain aerospace products to be sold in Canada and the United States. In the period 1980-1982 a total of approximately $120 million sales were generated using EDB. It should be noted that a percentage fee is charged by EDB for the use of this guarantee, and a condition often is that the seller goes on recourse for a portion of the loan. It is well documented that certain western countries subsidize sales financing for export of aircraft and related equipment. Financing rates as low as $8\frac{1}{2}$ per cent and a 10 or 12 year term have been offered by competitors over the last two years. The major trading partners of the western world have joined to agree upon export sales financing policies. Experience indicates that the current "consensus rate" of approximately 12 per cent is being violated. It is the practice of some nations to combine aid with commercial financing to give a lower (than consensus) blended rate.

The depressed world economic conditions in the last few years have led to serious financial difficulties in many lesser developed nations. Today countries such as Brazil, Poland, Mexico, Romania, Venezuela,

etc. are restructuring their massive hard currency debts. Many of these countries are traditional customers for Canadian Aerospace products. The position taken by the Canadian Government, EDC and Canadian banks regarding the future lending risks in these countries (compared with the position taken by other trading countries) will have a direct bearing on the immediate and future sales potential of members of the industry. It will also affect the "exposure fees" that are charged to exporters by EDC on sales they finance. In cases where loans exceed the normal risk the government can intervene to achieve a sale.(1)

To minimize foreign debt and to create local jobs, certain countries are demanding offset manufacture and/or barter as part of the proposal from aerospace companies. This trend is on the increase, particularly in some of the lesser developed countries. Due to depressed market conditions and the weak financial structure of many airlines American aircraft manufacturers have in the last year set up aircraft lease/buy arrangements with airlines. This is catching on. At least one European manufacturer has established leasing arrangements with institutions in the United States. The financial position of Canadair and de Havilland appears such that they will be unable to fully respond to this financing trend. The lease/purchase of major capital equipment such as aircraft has more generous tax treatment available to corporations or individuals in the United States than in Canada.

In many of the countries with which the Canadian Aerospace Industry competes, substantial front end assistance to product programs is provided by Government purchases. In general terms the Government concerned purchases a large block of product, say aircraft, at the front end of a new program, and by agreement with the manufacturer is willing to release delivery positions to fill export orders and take later delivery positions. This procedure not only places the manufacturer in a very favourable position with respect to early amortization of development, tooling, and early excess learning costs, but also enables short lead times in filling export orders. Examples of this system are:

(1) Under Section 31 of the Export Development Act the Governor of Council may authorize the corporation to extend terms outside of its normal limits.

Aeritalia: G-222 tactical transport airplane and the Italian Air Force;

Lockheed: C-130 transport and the United States Air Force

Embraer: Bandeirante and the Brazilian Air Force

Indonesia: Nurtanio and the Indonesian Air Force as well as airlines.

Some examples of the degree to which this applies in products directly competitive with Canadian industry are afforded by the following statistics:

Aircraft	Country	Approximate # in Country Govt. Service	Approximate Total Production	%
EMB110 Brasilia	Brazil	120	400	30
Casa 212	Spain	71	300	24
Jetstream	U.K.	30	87	35

4.4.5 Domestic Sales Financing

Canadian manufacturers have difficulty in competing against foreign companies in our domestic market. This occurs because the foreign manufacturer is able to offer subsidized sales financing terms through their equivalent of EDC. With no such instruments being available to the Canadian manufacturer, he can often find himself at a financing rate disadvantage as great as four or five points. Period of the loan and credit risk assessment of the offer can also be more advantageous from the foreign source.

The Committee knows of no government actions underway to correct this problem. However, in its opinion the potential exists for bilateral agreements between Canada and the competing countries manufacturing aircraft. This could lead to a common or a consensus type arrangement. It is believed that the United States has made such an arrangement with France. Recent press reports indicate that in the case of France they intend to provide a financing rate to domestic purchasers of aircraft manufactured in France that would be similar or the same as the rate they offer through their export credit agency.

A large percentage of the commercial and general aviation aircraft and helicopters operated in Canada were not acquired new. The purchase of used products has the obvious advantage of reducing capital investment of the operator. In some cases the equipment is first owned and operated in the United States where higher capital depreciation allowances are available. Once depreciated the equipment can then be moved across the border. If the aircraft and helicopter manufacturing industries are to be encouraged in Canada, additional incentives will be necessary to increase the new versus used equipment that is purchased for operation here.

5. STRATEGIC IMPLICATIONS

As a result of the industry/labour briefings and further discussions with knowledgeable persons in both areas, a number of key factors or strategic elements affecting the aerospace industry have emerged, consisting of those affecting the general structure and those more involved with major projects:

5.1 General Industry Structure

The following points have been summarized from the industry discussions and affect the overall industry capability.

5.1.1 Traditional Areas of Expertise

Since World War II, the Canadian aerospace industry has developed expertise in, and has successfully marketed, equipment and systems in several broad categories such as STOL transports, simulators, small engines, surveillance drones etc. A vast body of knowledge has been built up in these areas, leading to a natural competitive advantage in terms of follow-on systems. It is incumbent upon industry to make maximum use of its existing strengths, by continuing to develop improved products in those areas where Canada is strongest.

5.1.2 Market Niches/Windows

With a relatively small domestic market and limited industrial capacity Canada cannot hope to successfully compete on an across-the-board basis with industrial giants such as the U.S. Canada can, however, by judicious selection of market niches or windows, provide a concentrated effort in specific areas which can be highly profitable. For this strategy to be successful, it is necessary to identify the technical opportunities at an early stage, and provide adequate R&D funding in order to develop a strong competitive position at the earliest possible date.

5.1.3 Vertical Integration

As noted earlier, Canada is a world-leader in certain selected primary products and systems. Both the Government and industry, through their control of

these products, have an obligation to maximize the use made of Canadian procured subsystems and parts, insofar as possible. In some cases, it may be possible for a prime contractor to actually assist in developing Canadian companies with new (to Canada) technologies, through early identification of requirements and judicious application of subcontracting procedures. The probability of success will be enhanced if the major system is indigenous to Canada.

5.1.4 Joint Ventures

The development of more joint ventures in aerospace is an area which needs further exploration. This applies particularly to the field of systems integration where, individually, a firm could not qualify but, in conjunction with other firms with complementary abilities, could obtain the business.

The need for organized industry groupings has been evident in several major civil or military projects such as anti-submarine warfare systems, STOL systems and will become even more critical with such programs as the frigate-helicopter systems. It is highly desirable that Canadian industry develop teaming arrangements in order to benefit from the systems integration and the resulting combined development and production.

5.1.5 Subcontracting Roles

At present, the large part of the industry subcontract work is tendered, on a competitive basis, to a major (usually U.S.) original equipment manufacturer. This system, while effective in the past, is open to much more competition and our continued participation may be jeopardized unless a modified approach is adopted.

In this area of business, the general forms of working relationships with the OEM's have been summarized as follows:

i) Partnership

- the most independent but most risky arrangement, since total design/build package involved
- unlimited technical and financial risk
- highest potential ROI if program successful; compared to other arrangements

- requires proportionate share of development cost to be provided.

ii) Associate

- limited market and financial risk and little or no technical risk since design done under direction of OEM
- ROI not as high as (i) but better than participant or subcontractor
- up-front investment reduced from that in (i)

iii) Participant

- assured contract through pre-selected participation
- little market, financial or technical risk involved
- ROI higher than subcontractor

iv) Subcontractor

- competitive bidding and no pre-selection
- similar to the industry practice today
- very small market and financial risk and little technical risk
- lowest ROI of all.

In all the above arrangements, the contractor does not get paid until the delivery of the first aircraft by the OEM.

From the Canadian position, it was agreed that the role of a participant was the most beneficial and that any future discussions on major programs be based on this concept.

5.1.6 Changing World Environment

Prior to World War II, only half a dozen countries in North American and Western Europe had been able to establish a comprehensive aerospace capability. Since that time, sophisticated manufacturing and assembly equipment has been installed in such diverse, less-developed countries as Indonesia, India and Romania. These states have determined that a viable aerospace industry is an important national goal, and have developed industrial strategies to implement that goal. Canada has also clearly indicated its strategic desire to have a viable aerospace industry. However, it must now rapidly increase its technological level, if it is not to be squeezed out of the market by the rapidly industrializing Third World.

5.1.7 Industry Modernization

It is becoming more evident all the time that for the subcontract sector of the industry to survive it is essential that the basic plant and equipment be modernized. As a result of the rapid development in computer aided manufacturing, even the smallest shops will have to be capable of accepting electronic instructions, as against line drawings, if they are to remain competitive.

The degree to which the industry and government respond to this challenge, will shape the direction taken by a number of second and third tier companies.

5.1.8 Productivity Improvements

The aerospace industry is world-wide in scope, and almost all products face multinational competition. As Canada is a net exporter of aerospace products, it cannot afford to protect its own industry through tariff barriers, and must therefore remain competitive on a world-wide basis. Thus, productivity must continue to improve if competitive pricing is to be maintained. The industry cannot afford to be a high-cost producer on an overall basis without market protection, and market protection is patently impossible.

The productivity improvement program recently adopted by the AIAC companies is a positive step in this direction and commits the industry to a wide-reaching program designed to achieve measurable results in this area.

5.1.9 DND/DOT Procurement Policies

For a number of years and certainly since the late 1970's, it has become apparent that the Canadian Aerospace industry, hence the Canadian society, is not benefitting to the extent possible, from the very large DND and, to a lesser extent DOT, expenditures in new programs. It has been stated on any number of occasions that the policy of off-the-shelf procurement produces little net gain in enhanced industrial capability, and the resultant balance of trade improvements which would be expected.

There is the potential for extensive military R&D to be conducted by industry, with the technological spin-off flowing into the commercial systems. In as much as Canada is competing directly in the high technology areas, with economic systems based upon the above design, it is incumbent upon the government, if this high technology sector is to continue to provide the high ratio of exports to sales now experienced, to examine this situation with respect to both military R&D and the concomitant production. Continuation of the present situation will further reduce the industry competitiveness in the world market, and eventually lead to its demise.

5.1.10 Industrial Benefits Programs

Since DND aerospace procurement of Canadian designed equipment has been of minor significance to the industry, then the only fall-out from the present procurement policies is essentially a "build-to-print" capability developed through the industrial benefits programs, without any real state-of-the-art improvement in engineering or design.

Such programs do provide short term employment, but rarely develop into long term programs because the underlying technology, which is continually evolving, belongs to the original manufacturer and is seldom transferred.

In addition, the requirement for offsets is now rebounding on Canadian producers of original equipment and the industrial base in Canada, which would be required to respond to this situation, is not large enough to place such offsets, hence the business is lost.

The Defence Development Sharing Program should be revitalized. It is proposed that Canada negotiate participation in research and design study phase activity in selected defence technology areas with the U.S. These general technology and advanced design study programs would be funded in Canada, on terms equal to those provided by the defence partner. The condition for this participation would be equal and full access to participate in competitive design proposals and subsequent competition for selection for full scale product design and development and production contracts. When a Canadian company succeeded in winning a full scale development and production contract, the Canadian Government would fully fund the development and tooling stages of these programs under a procurement contract, and recover this investment on a negotiated basis on production program sales.

The concept here is that, by providing money for advanced study work, Canadian firms would have the opportunity to participate at the front end of military programs and hence have an opportunity to select a specialty area, for example, a special type of surveillance vehicle, a special navigation system, a special propulsion system, etc. and hence be in a position to have reasonable prospects of competing fairly and effectively in the subsequent major competition. Experience indicates that our NATO partners typically welcome participation in study work, so as to examine additional options, and hence have a wider selection for the subsequent main competition.

It is recognized that the foregoing concept will probably be effective only when the Canadian Department of National Defence participates actively in the process. Hence it is strongly recommended that, in addition to providing regular briefings to Industry on DND requirements, DND strengthen its resources and adjust its priorities to include a greater concern for maintaining and developing a defence related industrial capability in Canada. In this connection DND should steadily examine the potential for joint U.S. (or other NATO)/ Canadian requirements and be in a position to indicate Canadian DND support to such undertakings.

Finally, the foregoing concept could well be initiated under the umbrella of the DIP program but, if it is successful, it will be appropriate for DND to establish suitably sized R&D funds in the future to support, develop and enlarge this concept.

5.1.11 Skill Up-grade Programs

In view of the extensive restructuring of the industry brought about by the increased use of CAE, CAD/CAM, robotics and other productivity improvement technology and machinery necessary for industrial survival in the coming decade, it is essential that the aerospace labour force be trained and also retrained, as required, to enable the industry to take full advantage of the new technologies.

It is incumbent upon the industry to provide this training in a timely manner, not only to new entrants into the industry, but also to more senior workers, to enable them to upgrade their skills consistent with the advanced requirements. In order to avoid crisis situations, it is imperative that these training programs be planned and implemented with enough lead time, to ensure a smooth transition of trained labour, consistent with the emerging new requirements.

5.1.12 Systems Integration

The requirement for more closely integrated operational systems, particularly in the military avionics area, is becoming increasingly evident, and, in order to enable the industry to respond to this requirement, a stronger approach must be made in conjunction with the Government to expand the capabilities in this area.

The SKR program as well as the new frigate program could well be areas where this expertise could be further developed.

5.1.13 World Product Mandate (WPM)

It was noted that the WPM was a successful route taken by a number of companies who are subsidiaries of foreign firms. The development of effectively indigenous products by these firms, supported by the technology and marketing of the parent firm, has proven to be direct benefit to Canada.

The possibility of embarking upon extensive production programs either under license or on a lead company, basis suggests that the WPM concept be applied more broadly by Canadian firms on such dealings.

5.2 Major Programs

The Committee was briefed on the proposed, 150 passenger program with respect to possible Canadian participation.

In view of the lack of definition with respect to the Canadian work package, investment requirements, timing and other basic factors, it was the view of the Committee that, rather than attempt to make a recommendation based upon such disparate data, it would be more meaningful to suggest the basic strategy guidelines which might influence the Canadian position.

In effect, it was agreed that the following points be taken into consideration in evaluating these programs:

1) A minimum risk approach should be adopted. This could mean a pre-selected subcontractor role, if at all possible.

2) A lead company approach should be utilized in which a major Canadian firm acted on behalf of all other subcontractors.

3) The options should be kept open as long as possible with the OEM's in order to obtain the most suitable deal.

4) No program should be entered into unless it meets the test of economic viability.

When more complete data is obtained on the major programs, it will be possible for the government to evaluate, on a preliminary basis at least, the proposals based upon the technique described in the following section.

6. PRIORITIES FOR DEVELOPMENT ASSISTANCE

Although it was originally anticipated that this report would provide a ranking of importance of various aerospace projects relative to the availability of developmental funding or other assistance, the committee has determined that it would not be feasible to attempt to evaluate the projects in view of the conflicting views of its constituent members. Therefore, the committee has decided to limit its actions in this area to the development of a series of criteria by which these projects can then be evaluated in the proper context. A detailed explanation of the criteria weighting analysis and an example of how it is to be used, is included as Appendix B.

The committee selected nine key criteria for the analysis, as listed in Table 6.1. All possible pairs of criteria (36 decisions in all) were ranked against each other on a "one-zero" scoring system, according to each committee members' assessment of their relative importance. The scores were then summed, and normalized to add to a total figure of 100 units. This allows each criteria score to be expressed as a percentage of the total. Once the individual responses had been tabulated, they were averaged within each of the labor and industry groups, to yield two complete sets of criteria scores.

Figure 6.1 compares the two sets of responses graphically, according to the weight given (normalized score) to each criteria. The middle point represents the overall average score, at 50 per cent weight for each of the labour and industry averages. These overall averages are as follows:

No.	Criteria	Weighted Average Per Cent
6.	Sales	17.2
1.	Jobs	14.8
4.	ROI	14.8
2.	Manpower	10.6
5.	Exposure	10.6
3.	Facilities	8.8
7.	Technology	8.8
9.	Indigenous Products	8.1
8.	Regional Distribution	6.3

The criteria divide into two categories. The three critical ones, representing almost half the total weighting,

TABLE 0.1

PROJECT EVALUATION CRITERIA

1) Total number of jobs, expressed in man-years, provided over the lifetime of the project.

2) Availability of a skilled, or 'trainable on short notice' pool of manpower, which can be readily utilized for the project.

3) Availability of fixed facilities and capital equipment, such as plant, machinery etc., which can be readily utilized for the project.

4) Overall return on invested capital over the life of the project.

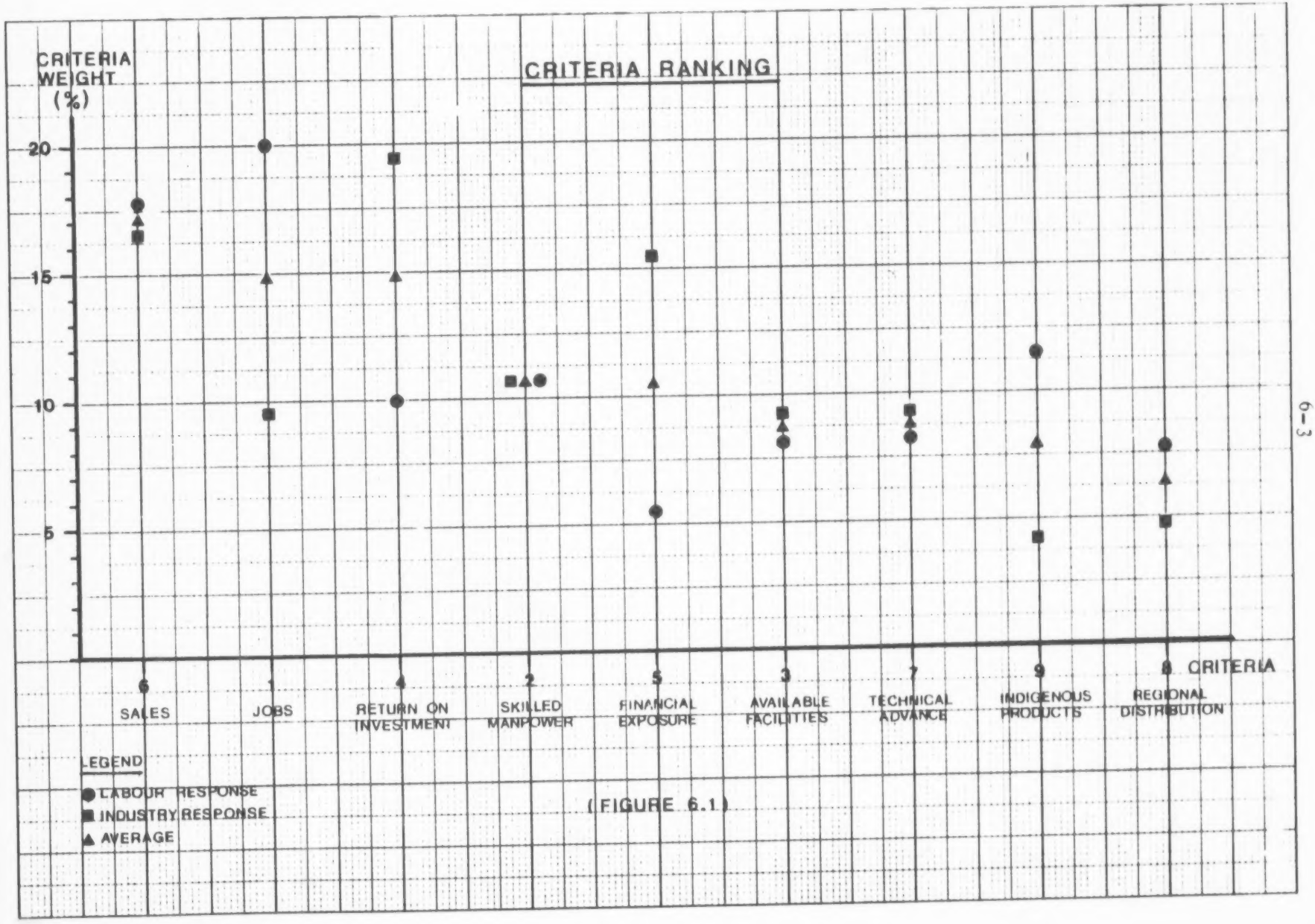
5) Level of financial exposure, as measured by the overall amount of discounted negative cash flow to breakeven. (The project with the lowest negative cash flow ranks highest).

6) Overall sales potential of the program and its derivatives.

7) The extent to which the project will contribute to technological advancement of the industry.

8) The extent to which the project will contribute to regional diversification.

9) The extent to which the project will maximize the use of indigenous products and services.


CRITERIA RANKING
CRITERIA WEIGHT (%)
20
15
10
5
6 SALES
1 JOBS
4 RETURN ON INVESTMENT
2 SKILLED MANPOWER
5 FINANCIAL EXPOSURE
3 AVAILABLE FACILITIES
7 TECHNICAL ADVANCE
9 INDIGENOUS PRODUCTS
8 REGIONAL DISTRIBUTION
CRITERIA
LEGEND
LABOUR RESPONSE
INDUSTRY RESPONSE
AVERAGE

(FIGURE 6.1)

are sales, jobs, and ROI. The remaining six criteria are grouped at a lower level, with relatively smaller differences between them.

It should be noted that industry and labor appear to be in general agreement on the relative importance of six of the nine criteria. In only three cases (Return on investment and financial exposure which industry ranks substantially higher, and provision of jobs, where the reverse is true) are there significant differences in the scoring. However, the committee has agreed to recommend the use of the average scores, as shown above.

7. RECOMMENDATIONS

The aerospace and avionics industry in Canada is at a critical point in its history, particularly the airframe and associated elements. A combination of a world-wide recession together with the emergence of competition in the export market from a number of countries hitherto considered primarily as customers, has seriously impacted the industry in the commercial sector.

The absence of DND procurement from Canadian industry in the equipment end-product area has resulted in a reduction in the competitive capabilities of the industry to respond to the latest U.S. and NATO military requirements.

This high technology industry, which in the last year exported about 77 per cent of its output, is a vital part of the industrial base of the country. However, if this level of exports is to be maintained or exceeded, and if the aerospace industry is to continue to remain as a lead industry in the country, then a number of factors which impinge negatively on the performance of this group, must be critically assessed and appropriate steps taken for rectification by industry, labor or government, as required.

The Advisory Committee on Aerospace, after extensive briefings and discussions with representatives of many sectors of the industry, as well as government, has agreed that there are a number of factors under the control, either wholly or in part, of the government which should be addressed by the Minister or his Cabinet colleagues. The following recommendations for action on the part of government by no means precludes, or limits, the quite often corresponding action required by industry or labor; they are intended to focus the government attention to those elements which are deemed to be of direct significance to the ongoing development and growth of the Canadian aerospace industry. The specific recommendations are summarized below:

7.1 Productivity Improvement

- The industry has launched a major and continuing program of productivity improvement and is committed to productivity target increases of 5 per cent and 6 per cent in 1984 and 1985 respectively.

- Greater assistance will be required through the capital element of DIPP if all firms are to enter the mainstream of CAE, CAD/CAM, robotics and the like, subject to the provisos of Section 7.2.

- The industry firmly supports the establishment of a National Productivity Centre. The CLC will consider the merits of participating in this Centre when full information about its operations is received from the government.

7.2 Research and Development

- The following recommendations are subject to company commitments on:

  - investment and employment in Canada.

  - R&D activity and development of particular expertise in Canada.

  - production exploitation of products resulting from shared development of projects.

  - the use of Canadian inputs and the development of new Canadian sources.

  - unrestricted access to international markets.

  - necessary manpower training activity in Canada.

- To attain the technology base necessary to be competitive in the next decade the industry is committed to an R&D performance target of 10 per cent of sales.

- Government support for R&D through economic development programs such as DIPP should be based on longer term sector plans of five years or more rather than only year-by-year allocations.

- The present DIPP criteria for assistance should be reviewed with industry as to the level of sharing and the guidelines for repayment of any contributions. The committee recommends that the norm be set at a level that makes the product competitive in the market place, and that grants be subject to repayment, including some recognition of interest on a negotiated basis.

- Long-term sharing agreements should be negotiated where appropriate, in order to improve the continuity in the development of new products.

- A detailed examination should be undertaken by industry and the investment community to increase the utilization of existing tax incentives so as to encourage increased investment in new product development.

7.3 Human Resources

- Since high-technology, by definition, requires a highly skilled work force, it is essential that the new entrants into the industry receive the highest quality of training possible. While industry provides specific product-oriented training, efforts must be made to improve both the skill levels and quantity of workers entering the industry. As indicated above, government grants would include "necessary manpower training activity in Canada" as a company commitment.

- Broader based training courses should be undertaken by technical institutions and the curricula for courses given should be worked out by joint labour/educational institution/industry groups such as CAMAQ in Quebec.

- The funding mechanism of a grant/levy system, which would assess all corporations on a pro rated basis, and which would reimburse those corporations which provide suitable training, should be examined and developed by a joint labour/industry committee at a national level.

- Increased use of CAE, CAD/CAM, robotics and other new technologies will require training and retraining of employees. Industry should provide the Unions sufficient advance notice of their investment plans and the introduction of new technologies so that the parties can negotiate the impact on the workers and the jobs before such changes are introduced.

- Retraining of existing workers from the aerospace industry and from declining industries, should be accelerated to help fill the employment requirements.

7.4 Technology Transfer

- Under the DPSA, Canada effectively agreed to orient its defence purchases to U.S. suppliers in exchange for access to the latest U.S. technology, which would enable the industry to compete for production. The intent of the agreement has evidently been overlooked from time to time, as Canada has occasionally been included with other foreign countries in restrictions on technology transfer. Canada should work steadily with all countries to eliminate protectionism in all forms.

7.5 Trade Finance

- Industry and labour are fully committed to the GATT aircraft agreement concerning aerospace products and services and deplore protectionism and unfair trade practices.

- The government should continue to strongly support the consensus on export sales financing practice and rates. Where countries violate the consensus, Canada should attempt to negotiate a settlement, and, if negotiations fail, be in a position to meet the competition.

- The Export Development Corporation should be provided with a pool of funds to be utilized in any action against violators of consensus. Also, Canada should endeavour to more closely tie aid funds with export sales financing, in order to make industry more competitive.

- EDC should commit to support customers, on a hedged "subject to" basis, at a much earlier stage than at present and both should accelerate their negotiation/decision process.

- An ad hoc task force should be constituted as soon as possible to confer with the Export Trade Development Board. They should be instructed to examine how the financial institutions, government and industry should respond to the increasing use of barter and counter-trade as an export financing instrument.

- Greater use of lease/buy arrangements are expected in the acquisition of aircraft and other equipment by U.S. purchasers. To maintain competitiveness, a mechanism should be adopted which would allow similar tax benefits to accrue to Canadian companies, as those currently available in the U.S.

7.6 Government Procurement

- The lack of appropriate lead times in communicating requirements, the development of specifications and pricing criteria, make it virtually impossible for Canadian firms to compete for a significant portion of major DND systems. The resultant policy of DND to buy "off-the-shelf" should be reviewed with a view of providing more advanced planning which would allow Canadian firms to bid on selected products.

- The Defence Development Sharing Program should be revitalized. It is proposed that defence technology areas with the U.S. (or other NATO and other friendly countries) be exploited on a joint participatory basis. These general technology and advanced design study programs would be funded in Canada, on terms equal to those provided by the defence partner. The condition for this participation would be equal and full access to participate in competitive design proposals and subsequent competition for selection for full scale product design and development and production contracts.

- Recognition by DND in co-operation with DRIE and DSS of the requirement to maintain a Defence Industrial Base and an increasing commitment to purchase a substantial share of its capital equipment and support in Canada. This would provide a meaningful increase in the capabilities of the industry.

- To enable appropriate industry participation in the development of military systems, the DND annual capital budget should be reallocated, to cover development work to be subcontracted to industry.

7.7 Systems Integration

- As a plan of action and in order to strengthen the industrial defence base, it is recommended that DND procurement of advanced systems be used by government and industry to develop and broaden Canada's capability for systems integration.

7.8 Space

- The partnership between government and industry in space has proven to be effective and it is recommended that, to ensure continuity for the program, at least one major project should be in the build-phase at any one time.

7.9 Major Projects

- The following recommendations are made in connection with the resolution of such major programs as the 150 seat transport:

  a) a lead company approach be adopted in which a major firm acts as a prime and provides a a focal point for other Canadian participation by subcontractors.

  b) a minimum risk role be assumed which could mean that of a preselected subcontractor.

  c) options with the original equipment manufacturers should be kept open as long as possible.

  d) any program entered into must meet the test of economic viability.

- In regard to possible major helicopter projects the following recommendations are made:

  a) an established helicopter company/ies should be encouraged to establish a Canadian subsidiary with a world product mandate for a particular segment or element of the market, or a joint venture should be undertaken with an existing Canadian firm again with a world product mandate being given for a particular market segment or element.

b) development support for the new venture should be contingent on a clear plan to progressively increase the Canadian based design and development so as to ensure a major portion of the engineering work as well as production and marketing are undertaken in Canada within a reasonable time interval.

7.10 World Product Mandate

- Government support should be directed primarily towards firms pursuing world product mandates on the basis of R&D and technical development in Canada, and the conditions in (7.2) above should apply.

- In conjunction with (7.6) ensure that as many products as possible, obtained under any industrial benefits program, be subject to a world product mandate.

7.11 Statistical Base

- The present statistical information available on the aerospace industry is deficient in a number of areas. It is recommended that industry, labour, and government together develop a more comprehensive data collection and analysis package which will assist all parties in the future.

- Industry is committed to undertake the foregoing on a shared cost basis.

The Committee believes that the foregoing recommendations, in conjunction with the information in the other sections of the report, will provide the Minister with the requisite assessment of the aerospace industry.

In view of the number of recommendations, as well as the problems which exist and will continue to exist, as to the disposition of major programs, such as the 150 seat transport and helicopters, it is recommended that the Advisory Committee be kept in being and utilized on a periodic basis to assist the Minister in the resolution of the above issues.

APPENDIX A

AVIONICS & ELECTRONICS PRODUCT LISTING

Avionics and electronics product listing includes:

- Inertial Navigation Systems
- Cockpit Displays
- Maritime Radar
- Automatic Test Equipment for Airborne Systems
- Fire Control Systems
- ASW Systems
- Temperature Control Systems
- Flow Control Systems
- Engine Thrust Trimming
- Microwave Landing Systems
- Airborne Sea and Ground Communications Systems
- Search and Rescue Communication Systems
- Sophisticated Electronic Components, i.e. Microelectronic and Hybrid Devices
- Peripheral Vision Displays

APPENDIX B

CRITERIA EVALUATION PROCEDURE

Initially, 18 criteria were selected for evaluation, as per Table B.1, and these were discussed in detail with the committee co-chairman. At that time, it was decided to reduce the number in order to drop those which had limited importance, and to merge several sets to reduce the problem of multi-collinearity. After a preliminary binary ranking, and further discussion, the set was reduced to the following 9 shown in Table B.2.

The ranking of these criteria, and the weights assigned to them, were based on binary decision theory, in which each criteria is compared to every other criteria in pairs, and a score of 1 unit given to the more important criteria. In the case of 9 criteria, there are 36 individual decisions to be made.

The criteria listing was given to each committee member to fill out individually, to elicit the widest possible range of viewpoints. A comparison of responses is shown in Table B.3. From this, it can be seen that the industry responses grouped the criteria in three broad classes. Numbers 4, 5 and 6 (ROI, exposure, sales) ranked uniformly high, number 8 and 9 (regional diversification, indigenous products) ranked very low, with the remaining criteria in a middle position. The labour responses fell into groupings also. Number 1 and 6 (jobs, sales) ranked very high, with the remaining criteria grouped in the low to middle ground.

The overall scores, at 50 per cent weight for each of the labour and industry averages, are as follows:

No.	Criteria	Weighted Average Per Cent
6.	Sales	17.2
1.	Job	14.8
4.	ROI	14.8
2.	Manpower	10.6
5.	Exposure	10.6
3.	Facilities	8.8
7.	Technology	8.8
9.	Indigenous Products	8.1
8.	Regional Distribution	6.3

TABLE B.1

SUBSECTOR EVALUATION CRITERIA - INITIAL

1) Quantity of jobs created (man-years of employment).
2) Availability of qualified personnel.
3) Magnitude of R&D required (DIPP or equivalent).
4) Magnitude of required facilities/capital equipment.
5) Availability of private sector financing.
6) Return on investments (government and private).
7) Maximum potential financial exposure.
8) Time to reach breakeven.
9) Export potential.
10) Project implementation time.
11) Market potential of programs and derivatives.
12) Contribution to technological advancement.
13) Technological risks.
14) Regional diversification.
15) Contribution to Canadian sovereignty.
16) Contribution to defense self-sufficiency.
17) Contribution to development of small business.
18) Indigenous products or services.

TABLE B.2

PROJECT EVALUATION CRITERIA - RECOMMENDED

1) Quantity of jobs.

2) Availability of skilled manpower (includes actual plus trainable on short notice).

3) Availability of fixed facilities and capital equipment.

4) ROI over program life.

5) Minimization of financial exposure.

6) Overall sales potential of program and derivatives.

7) Contribution of technological advancement.

8) Contribution to regional diversification.

9) Use of indigenous products and services.

TABLE B.3

CRITERIA RANKING

INDUSTRY (6 COMPLETE RESPONSES)						
CRITERIA	NORMALIZED SCORES			RANK[1]		
	HIGHEST[2]	LOWEST[2]	AVERAGE	HIGHEST	LOWEST	AVERAGE
1	16	7	9.6	2	9	5
2	16	7	10.7	3	7	4
3	13	2	9.3	3	9	6
4	20	18	19.6	1	2	1
5	20	11	15.6	1	5	3
6	18	16	16.7	2	3	2
7	13	7	9.3	3	7	6
8	11	2	4.8	5	9	8
9	11	2	4.4	5	9	9

LABOUR (2 COMPLETE RESPONSES)						
CRITERIA	NORMALIZED SCORES			RANK[1]		
	HIGHEST[2]	LOWEST[2]	AVERAGE	HIGHEST	LOWEST	AVERAGE
1	20	20	20.0	1	1	1
2	13	8	10.6	3	7	4
3	10	7	8.3	5	7	6
4	13	7	10.0	3	8	5
5	9	2	5.6	6	9	9
6	18	18	17.8	2	2	2
7	12	4	8.3	4	8	6
8	13	2	7.8	3	9	8
9	13	10	11.7	3	5	3

(1) A seventh response used in computation of high and low ranges.

(2) Rounded totals.

The criteria weights can now be used to evaluate projects. Each project can be compared to each other, against each criteria, according to the binary system. The scores against each criteria are then multiplied by the criteria weight, and summed over all criteria, to yield a weighted project ranking. As an example of how much a weighting might be accomplished, consider the following hypothetical projects to be compared to each other:

a) Light twin-turbine helicopter assembly facility in New Brunswick.

b) Airbus/de Havilland A-320 program.

c) De Havilland development of a 100 passenger augmentor-wing/ejector lift transport.

The procedure to be used now follows the four sequential steps as shown below:

1) Assess Project Parameters

For the purposes of this exercise, which is an example of the procedure only, values were arbitrarily assumed for such factors as job creation, ROI, sales potential, etc. For an actual case study, these factors must be much more closely examined.

2) Rank Each Project Against Each Criteria

As per Table B.4.

3) Weight Scores According to Criteria Weights

As per Table B.5.

4) Evaluate Results

In this example, project (c), the augmentor-wing transport, has a substantially greater score than the other two. This occurred because it was assessed as best against the most heavily weighted criteria (6. Sales Potential, 1. Jobs, 4. ROI).

TABLE B.4

PROJECT RANKING AGAINST CRITERIA(1)

1. Job Quantity

A	0	0	0	1
B	1	0	1	2
C	1	1	2	3

2. Manpower Availability

A	0	1	1	2
B	1	1	2	3
C	0	0	0	1

3. Capital Availability

A	1	1	2	3
B	0	1	1	2
C	0	0	0	1

4. ROI

A	0	0	0	1
B	1	0	1	2
C	1	1	2	3

5. Financial Exposure

A	1	1	2	3
B	0	1	1	2
C	0	0	0	1

6. Sales Potential

A	0	0	0	1
B	1	0	1	2
C	1	1	2	3

7. Tech. Advancement

A	1	0	1	2
B	0	0	0	1
C	1	1	2	3

8. Regional Diversification

A	1	1	2	3
B	0	0	0	1
C	0	1	1	2

9. Indigenous Products

A	1	0	1	2
B	0	0	0	1
C	1	1	2	3

(1) All scores increased by 1 to avoid zeros. Choice of 1 is arbitrary, and any non-zero number can be used.

TABLE B.5

PROJECT WEIGHTED SCORES

CRITERIA	WEIGHT	WEIGHTED SCORE		
		A	B	C
1	148	148	296	444
2	106	212	318	106
3	88	264	176	88
4	148	148	296	444
5	106	318	212	106
6	172	172	344	516
7	88	176	88	264
8	63	189	63	126
9	81	162	81	243
TOTAL	1,000	1,789	1,874	2,337
NORMALIZED SCORE		29.8	31.2	39.0

APPENDIX C

GLOSSARY OF TERMS

AIAC	Aerospace Industries Association of Canada
ASW	Anti-Submarine Warfare
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CAM	Computer Aided Manufacturing
CAMAQ	Centre for Aerospace Manpower Assessment in Quebec
CCPE	Canadian Council of Professional Engineers
CEIC	Canada Employment and Immigration Commission
COPS	Canadian Occupational Projection System
CPF	Canadian Patrol Frigate
DDSA	Defence Development Sharing Agreement
DIPP	Defence Industry Productivity Program
DLIR	Depot Level Inspection and Repair
DND	Department of National Defence
DOD	Department of Defense (U.S.)
DOT	Department of Transport
DPB	Defence Programs Branch
DPSA	Defence Production Sharing Agreement
DRIE	Department of Regional Industrial Expansion
DSS	Department of Supply and Services
EDB	Enterprise Development Board
EDC	Export Development Corporation
FATIC	Final Assembly and Test in Canada
FRG	West Germany
FST	Federal Sales Tax
GNP	Gross National Product
IAM&AW	International Association of Machinists and Aerospace Workers
MLUP	Mid Life Update
NATO	North Atlantic Treaty Organization
NC	Numerical Control
OEM	Original Equipment Manufacturer
PEMD	Program for Export Market Development
PRC	Procurement Review Committee
R&D	Research and Development
R&O	Repair and Overhaul
ROI	Return on Investment
RPV	Remote Piloted Vehicle
SDF	Source Development Fund
SKLE	Sea King Life Extension
SKR	Sea King Replacement
STOL	Short Take-Off and Landing
UAW	United Auto Workers
U.K.	United Kingdom
UPP	Unsolicited Proposal Program
U.S.	United States
USAF	United States Air Force
USN	United States Navy
VHSIC	Very High Speed Integrated Circuits
VTOL	Vertical Take-Off and Landing
WPM	World Product Mandate